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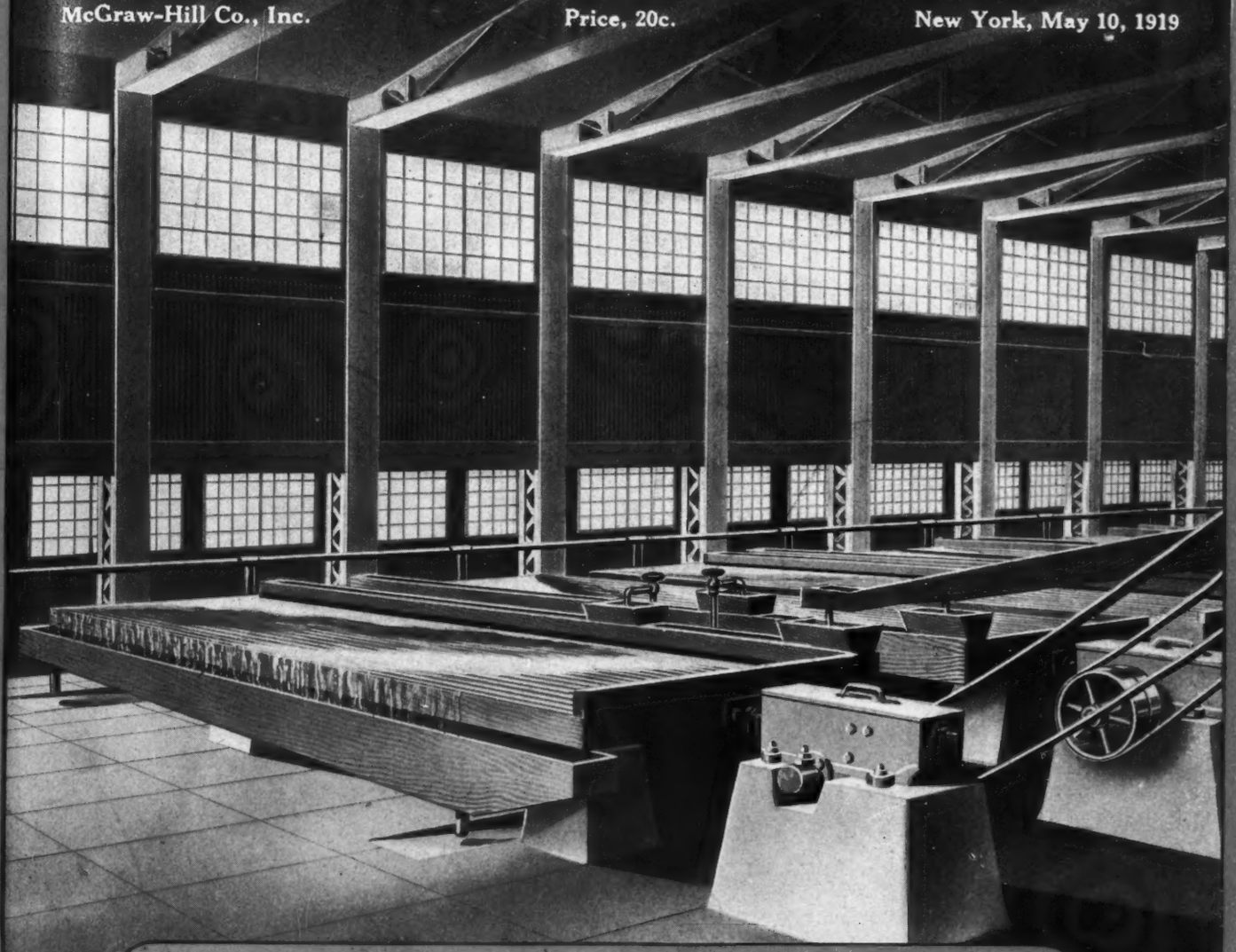

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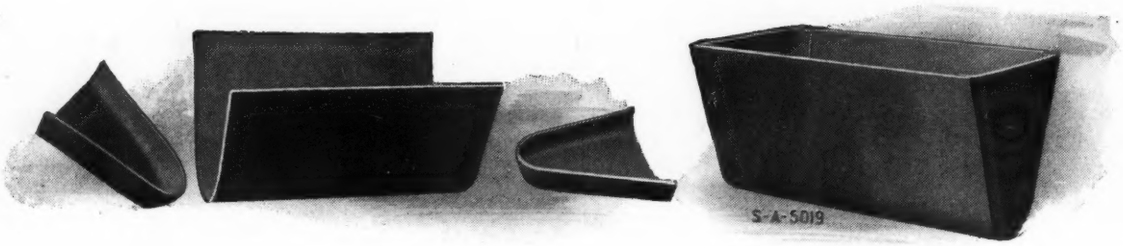

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Copper-Smeltery Slag From the Microscopic And Chemical Point of View

BY C. G. MAIER* AND G. D. VAN ARSDALE†

Consideration of the subject demonstrates that the available methods for studying the problems of the real constitution and the mutual behavior of fused slag and mattes are limited. Investigation of solidified slags is comparatively simple, although data on this phase of the subject are incomplete. Conclusions from such work must be of limited applicability to the fused state; but if the limitations are kept constantly in mind much can be learned. The method pursued in the investigations described was a combined microscopical and chemical one, and it has been found capable not only of yielding results from which more or less definite conclusions could be formulated as to the mode of occurrence of copper in slags, but it has also disclosed the possibilities of obtaining a more exact knowledge of some of the usual smelting phenomena. The authors present discussions and conclusions with respect to (1) the different forms in which copper occurs in the slags examined and the relative amounts of such different forms, and (2) reasons for the occurrence of these forms.

A NUMBER of theories have been proposed as to the form in which copper occurs in slag, and as an excellent review of the published work on the subject has been compiled by F. E. Lathe,[1] it is unnecessary to reiterate discussion of previous opinions. Comment, however, may be made on some of this published material, from the standpoint of the work summarized in the present paper. Lathe's summary has been utilized as well as the original articles.

W. A. Heywood[2] has illustrated by graphic method the relationship between the copper content of matte and its corresponding slag. The impropriety of speaking of the solubility of matte is emphasized in a succeeding paragraph. For the same reasons, and although there is doubtless a relationship between the grade of matte and the copper content of slags, this should be considered more as a rough practical assumption of condition rather than a true relationship. Lathe sums up L. T. Wright's[3] reasons for doubting that all the copper in slags is in the form of prills of matte as follows:

"1. That matte did not separate from slag kept in the molten state even for a long time."

As a matter of practical experience, it seems established that increased settling of some slags results in a separation of suspended copper. On the other hand, increased settling of other slags, under other conditions, as in Wright's work, does not result in any settling out, although it may be assumed that, in both cases, suspended copper is present. It is reasonable to believe that the cause for such different action may be found by a microscopic examination, as indicated later, and that the use of the method of determining suspended copper, to be described, will give the theoretical limit to which any particular slag can be settled.

"2. That no concentration of the valuable metals was possible by elutriation after fine grinding."

It is possible with some slags to make a separation by flotation, after fine grinding, of suspended sulphide constituents.

With respect to the fact that the proportions of gold, silver, and copper in slag are often different from those of the accompanying matte, it has been found, in the slag examined, that unaltered matte inclusions are comparatively rare. The proportions of gold, silver, and copper in the altered sulphide inclusions, visible under the microscope, would certainly be expected to vary from those in the original matte.

J. Parke Channing and J. E. McAllister[4], in commenting on Wright's work, were of the opinion that a considerable part of the copper entered the slag as oxide or silicate, and not as sulphide. Although this may be true of Wright's slags and of those at the Tennessee Copper Co., spoken of by Channing, it seems certain that this is not the case for the slags under present consideration.

F. A. Sundt[5], from results at Chilean smelteries, finds a relationship between the copper content of the charge and that in the slag. T. Kiddie[6] used treatment with dilute sulphuric acid as a method for direct de-

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[1] *Eng. and Min. Journ.*, 1915, Vol. 100, p. 215.

[2] *Eng. and Min. Journ.*, 1904, Vol. 77, p. 395.

[3] *Trans.* A. I. M. E. 1909, Vol. 40, p. 492.

[4] *Trans.* A. I. M. E. 1910, Vol. 41, p. 885.

[5] *Eng. and Min. Journ.* 1910, Vol. 89, p. 1097.

[6] *Journ.* Can. Min. Inst., 1911, Vol. 14, p. 487.

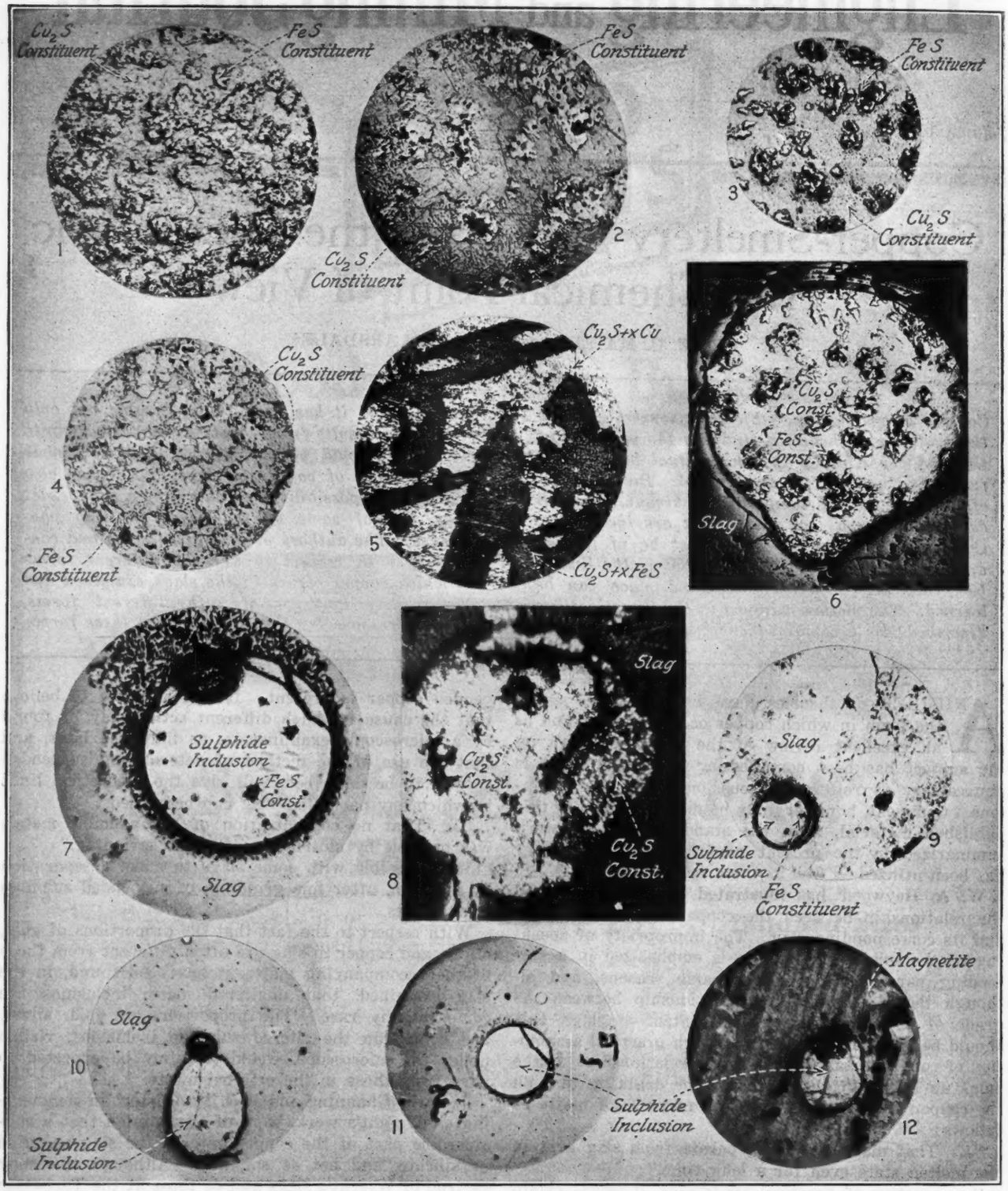


Fig. 1. Matte to converter, unetched. The islands of light material, surrounded by dark outlines, are FeS constituent, polished in relief. **Fig. 2.** Reverberatory matte, unetched. Picture taken with W. & W.-B. filter, to show more clearly lighter FeS constituent as islands in ground mass of copper-sulphide constituent. The dark spots are cavities, which may have been originally present, or more probably are due to breaking out harder but more brittle FeS constituent during polishing. **Fig. 3.** Blast-furnace matte, unetched. The appearance of the Cu_2S constituent in the ground mass is characteristic, and should be compared to later figures showing sulphide inclusions in slags. **Fig. 4.** Blast-furnace matte, unetched. **Fig. 5.** White metal. Tinted by standing in air and laboratory fumes. W. & W.-B. filter was used in taking this picture, as dark areas are nearly indistinguishable from the light by white light. Note similarity between light constituent and background of matte. **Fig. 6.** Blast-furnace slag, chilled, unetched. A sulphide inclusion is shown which is practically unaltered matte, as seen by comparison with Fig. 3. Note large size of inclusion, and partial separation of constituents by specific gravity, as seen by the distension of globule at bottom. **Fig. 7.** Blast-furnace slag, chilled, unetched. Shows a sulphide inclusion, with attached gas bubble at top, and surrounded by minute bubbles in body of slag. Note few remaining islands of FeS constituent. **Fig. 8.** Reverberatory slag, chilled, etched with HF. Small sulphide inclusion, highly magnified, showing the separation of iron sulphide containing material from residual copper-sulphide constituent by action of slag. **Fig. 9.** Blast-furnace slag, chilled, unetched. Only traces of iron-sulphide constituent remain, with well-defined field of minute bubbles about inclusion. Unassimilated charge is evident in the body of the slag as white and dark spots. **Fig. 10.** Blast-furnace slag, chilled, unetched. An excellent illustration of gas bubbles remaining after complete elimination of iron-sulphide constituent. **Fig. 11.** Blast-furnace slag, chilled, unetched, horizontal section. A sulphide inclusion free from iron-sulphide constituent. Some undigested charge. **Fig. 12.** Reverberatory slag, etched with HF. The relationship of the sulphide inclusion, and its attached gas bubble, to the vertical string of free gas bubbles, is clearly indicated. Skeletal crystals of magnetite forming on solidification show excess of Fe_2O_3.

termination of oxide copper in slags. It is known that ferric iron will cause the solution of sulphide copper, and that ferrous sulphide can precipitate copper from solutions. Slag samples, as usually obtained, contain ferric iron and at least some matte particles, so that the method for determining oxide copper in slag cannot be accepted as accurate in every case.

C. A. Grabill[7] classifies slag losses as physical and chemical, "the former consisting of those due to poor settling, insufficient difference of specific gravity of matte and slag, and gas flotation"; but he considered that "all of these were small under normal conditions. The chemical losses might be due to the formation of copper oxide or to solution of metals and sulphides." The last he considered most important. The experiments here under review indicate that gas flotation is an important cause of trouble in the slags examined. Copper truly dissolved in slag is also an important factor, so much so that in these slags it was reasonable to conclude that the two factors are the principal ones, and that others are negligible.

W. A. Wanjukoff[8] gives the results of an elaborate series of direct-solubility determinations by fusion in the laboratory, including the effect of variations of bases and acidity. Some of the photographs appended to his original article show inclusions which would warrant doubt as to the accuracy of certain of his conclusions on the relationship between the total copper content and the true solubility.

J. W. James[9] concludes from the reduction of copper content of converter slag (passed into a reverberatory), by treatment with green poles, that much of the copper must have been present as oxide. It is probable that this effect may have been due to eliminating the factors causing the gas flotation of particles, to be referred to subsequently. The reduction of residual copper by the addition of pyrite, after this poling treatment, might be equally an indication of dissolved copper present as sulphide, which is reduced by the addition of pyrite, as in experiments to be described.

Mr. Lathe's[10] determinations of oxide copper are open to the same objections as Mr. Kiddie's. The method of determination, though possibly giving correct results on some slags, will certainly not do so on others.

As a preliminary to the presentation and discussion of results, Table I has been compiled. Granting that copper in slags may exist in two forms, visible and invisible under the microscope, the first or visible particles (Group 1) may be found obviously as micro- or macroscopic particles. The copper microscopically invisible may be divided as Group 2 (ultra-microscopic particles or colloidal solutions or suspensions), and as Group 3 (true solutions). The possible forms of occurrence under each main heading are as shown in the next horizontal division of the diagram. The actual observed occurrences and conclusions are as shown in the next horizontal division, and the indicated lines for experiment are shown next below.

Visual distinction between Group 1 and Groups 2 and 3 may be made directly by the microscope in a qualitative way; and, based on microscopic evidence, a chemical method has been worked out which it is believed can be used to distinguish quantitatively between particles of mechanically retained matte or copper sulphide and that dissolved either as true or colloidal solution.

Visual Evidence as to Suspended Sulphide Inclusions

That the matte and other sulphide inclusions in slag may be readily recognized, microphotographs of matte and white metal have been made. Figs. 1, 2, 3 and 4 show the appearance of polished surfaces of mattes of from 30 to 40% Cu, consisting essentially of a blue (dark) eutectiferous background with yellow (light) islands of iron sulphide. This identification may be accomplished with two etching agents, sulphuric acid, which attacks the iron sulphide constituents, and silver nitrate, which precipitates silver and silver sulphide on the Cu_2S-containing constituents.

For comparison, Fig. 5 shows a white metal of 75% copper, which consists of a ground mass of copper sulphide (probably containing dissolved copper) with a more readily oxidizable eutectiferous background ($FeS + xCu_2S$), corresponding to the ground material in Figs. 1, 2, 3 and 4. These two phases of white metal are difficult to identify microscopically, inasmuch as the ordinary etching agents attack them with practically the same activity, and the color of the freshly polished surface is nearly a uniform steely blue. For this reason, the pictures of inclusions in slag do not ordinarily show constituents. On slow corrosion in air (particularly laboratory fumes) however, the constituent containing iron sulphide becomes covered with a thin reddish film, probably consisting of Fe_2O_3. Appropriate color screens and color-sensitive plates may then be used to distinguish between the phases.

The examination of polished slag sections soon reveals the fact that matte, as such, and similar to Figs. 1, 2, 3 and 4, occurs only seldom, whereas it is usual

TABLE I. COPPER IN SLAGS

Microscopically	Visible				Invisible							
Physical Forms	Group 1 Macro / Micro scopic particles				Group 2 Ultramicroscopic particles / Colloidal solution			Group 3 True Solutions				
Possible Forms	(Matte)	Cu_2S	Cu	Dissolved in FeS	(a) Matte	Cu_2S	Cu Oxides and Silicates	Cu_2S	Cu and Oxides	Cu_2O / CuO (SiO₂)	Cu_2O / CuO	Fe_2O_3 / Al_2O_3
Actual occurrence as observed or concluded	Occasional	Usual	Seldom, oxides or silicates not observed	If so, very small in amount	Very improbable	Probable	Improbable	Probable	Improbable	Improbable	Improbable	
Indicated lines for experiment	Settling by control: Temperature / Density / Viscosity Prevention of flotation.				Coagulation and Settling			Salting out: By variation of constitution. By additional agents.				

(a) Matte is a variable complex material containing at least two constituents, one of which is readily attacked by Fe_2O_3, and it is not proper to speak of its solubility as such. There must also, therefore, be a limiting size to the matte particles, below which they cannot exist in suspension.

[7] *Eng. and Min. Journ.*, 1910, Vol. 89, p. 776.
[8] *Metallurgie*, 1912, Vol. 9, p. 1.
[9] *Eng. and Min. Journ.*, 1914, Vol. 97, p. 1114.
[10] *Eng. and Min. Journ.*, 1915, Vol. 100, p. 215.

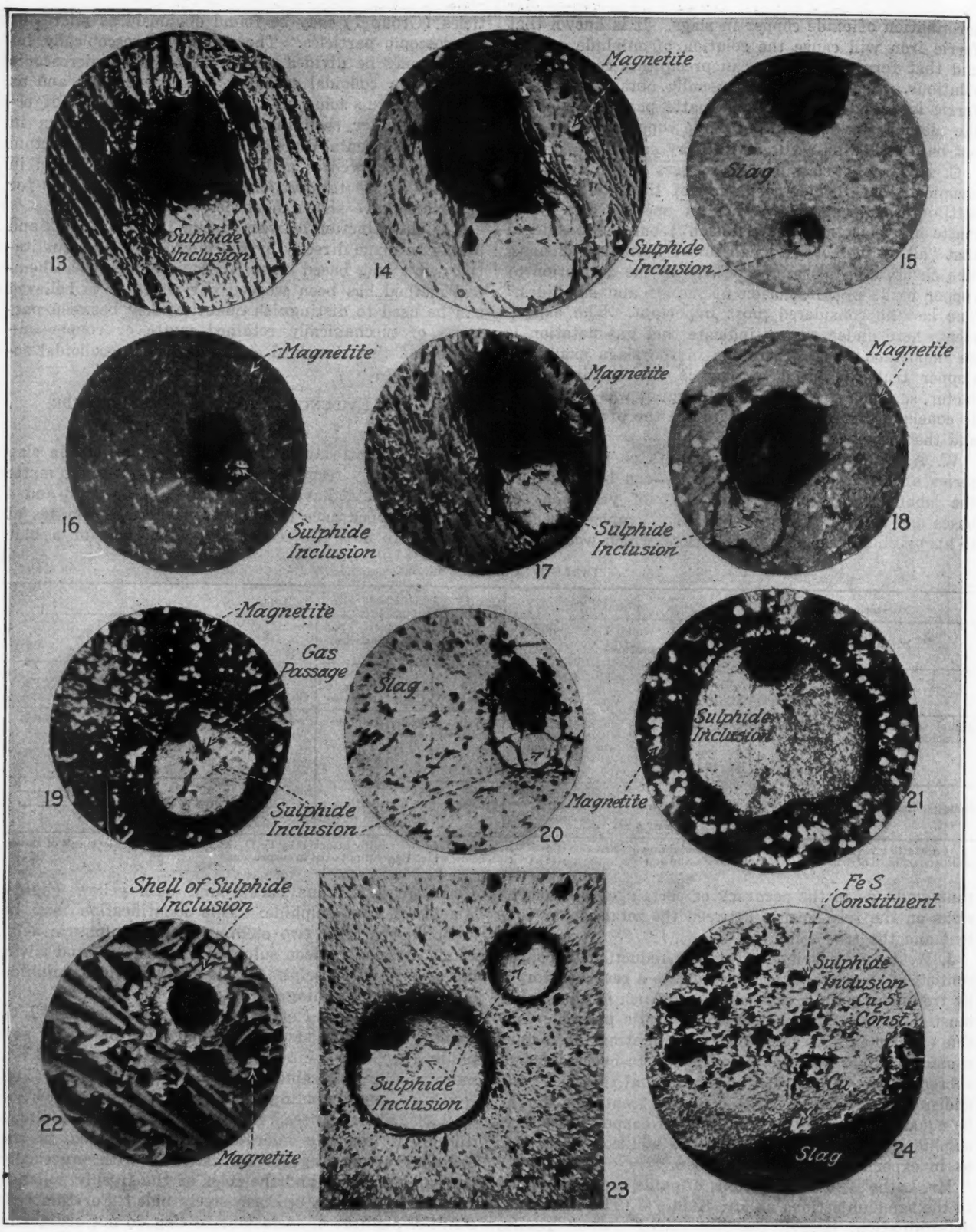


Fig. 13. Reverberatory slag, etched with HF and repolished. Note apparent disintegration of sulphide inclusion. Fig. 14. Limpid converter slag, unetched. The bubble seems to have been confined by the solidification just at point of leaving pellet of sulphide to which it is attached. Fig. 15. Limpid reverberatory slag, unetched. The clean bubble at the top may have left the lower one just before solidification. Fig. 16. Limpid reverberatory slag, unetched. Sulphide inclusions a mere shell. Fig. 17. Converter slag, unetched. The sulphide pellet was very large. Fig. 18. Converter slag, unetched. Fig. 19. Reverberatory slag, etched with HF. Gas passage in sulphide inclusion, leading to bubble at top, is of interest. Fig. 20. Blast-furnace slag, chilled, etched with HF. For comparison with Fig. 19. Fig. 21. Reverberatory slag, etched with HF. The eutectoid-like appearance of the sulphide inclusion shows the possible variation of copper content even in copper-sulphide constituent alone. Fig. 22. Reverberatory slag, etched the HF. A horizontal section which accidentally cut a sulphide inclusion and attached gas bubble near top, so that only ring of sulphide is visible. Fig. 23. Converter slag, unetched. The position of the bubbles in the two sulphide inclusions, in the same plane, is significant evidence of the flotation effect, as distinguished from purely accidental cavities. Fig. 24. Blast-furnace slag, unetched. The presence of metallic Cu in the sulphide inclusion is to be particularly noted.

to find considerable numbers of particles of copper sulphide constituent, similar to the copper sulphide-iron sulphide eutectoid, appearing as the background of matte in Figs. 1, 2, 3 and 4.

This fact is strikingly illustrated by a comparison of Fig. 6 with the subsequent pictures. Fig. 6 represents a rare case where the matte has been preserved practically intact. It is especially interesting to note a separation of constituents by specific gravity while still partly liquid, as is evident from the small projection at the bottom of the matte globule, containing FeS constituent. Fig. 8, a much higher magnification, shows a partly altered inclusion. Cu_2S (or Cu_2S + X Cu) Cu_2S — FeS eutectoid and FeS constituent are seen together, illustrating the process of disappearance of the iron-sulphide islands. In Fig. 7 the disappearance of the iron-sulphide constituent is practically complete. The gas bubbles surrounding the sulphide globule are of interest, and may be accepted as evidence of a reaction between some constituent of the slag and the original matte inclusion.

Fig. 9 shows a sulphide inclusion with still less visible iron-sulphide constituent. Fig. 11 illustrates a sulphide inclusion with no visible iron-sulphide constituent. Fig. 10 indicates the gas passages in the sulphide globule leading into the gas bubble at the top. The remaining figures up to Fig. 24 show characteristic sulphide inclusions in blast-furnace, reverberatory, and converter slag. Fig. 24 depicts the possibility of the presence of metallic copper. This is rare, and experience justifies the assumption that no metallic copper occurs except in sulphide inclusions.

By summing up in a general way the evidence furnished by these photographs, the following conclusions are warrantable:

1. Globules of copper-sulphide constituent (copper sulphide with dissolved FeS) or copper sulphide-iron sulphide eutectoid are a usual and universal constituent of all slags examined.

2. Matte, as such, is found only occasionally.

3. Copper has been identified, but only in the interior of sulphide inclusions.

4. Iron-sulphide constituent is seldom to be observed in sulphide inclusions, and, in cases of slags corresponding to high-grade mattes, no separate pellets of iron sulphide have been found. The copper content present in slags, dissolved in FeS, is, therefore, probably small and negligible, as the total solubility in FeS, as indicated by experiments to be discussed later, is only from 0.5 to 2.0 per cent.

5. A striking fact in connection with Figs. 6 to 24 is the frequent attachment of gas bubbles to sulphide particles.

6. It is evident that there is a chemical action between the original matte particle and some constituent of the slag. All stages, from the original matte containing iron-sulphide constituent, through the partial disappearance of the latter down to its final complete elimination, while Cu_2S is still present, can be traced, so that it is evident that this chemical action operates first on the iron-sulphide constituent of the matte. In some cases, a gradual reduction of the Cu_2S, with an occasional appearance of metallic Cu, may be noted, and it is probable that the reaction takes place also with Cu_2S, although more slowly than with the iron constituent.

7. It is evident that suspension of inclusions by gas bubbles in the fused slag must be one of the considerable sources of copper loss through retention of sulphide globules. Evidence will be presented as to the cause for this flotation of sulphide globules.

The determination of the amount of copper which might be saved by complete elimination of suspended particles is a subject of considerable practical importance. The visually evident fact that all particles do not contain uniform amounts of copper precludes attempt to make direct count and estimation by micro-metric means. Early in the investigation, when experiments were being made to determine the effect of various etching agents on slag and other products, it was noted that there was no microscopic evidence of action by dilute neutral silver-nitrate solutions on the body of the slag, but that there was rapid and distinct action of the solution on the sulphide globules. This seemed to indicate the possibility of the use of this reagent as a method of determining the amount of suspended copper and (by difference) the amount of invisible or dissolved copper.

The possibility of dissolving matte or copper sulphide globules in neutral $AgNO_3$ solutions, as a means of determining the amount of suspended[11] (and consequently, by difference, the dissolved) copper, rests on the following assumptions:

1. That the body of the slag, or its dissolved substances, are not attacked by the solution of silver nitrate.

2. That the copper-sulphide globules will be dissolved with reasonable rapidity and with a fair degree of completeness.

Assumption No. 1 was tested by direct microscopic observation, no visible action being found. To test the completeness of solution of the copper-sulphide globule content, samples of matte and white metal were finely ground and treated with 1% $AgNO_3$ solution in double excess over the amount theoretically required to dissolve copper sulphide according to the equation

$$Cu_2S + 4AgNO_3 = 2Cu(NO_3)_2 + 2Ag + Ag_2S$$

The results of the tests are shown in Table II.

TABLE II. SOLUBILITY OF COPPER IN MATTE IN 1% $AgNO_3$ SOLUTION

	Per Cent. Cu	Per Cent. Cu Soluble in $AgNO_3$	Difference	Per Cent. of Total Cu Soluble
Blast-furnace matte	36.75	35.90	0.85	97.7
Reverberatory matte	33.40	32.75	0.65	98.1
White metal	76.00	75.50	0.50	99.3

The solution of the copper content is seen to be nearly if not entirely complete. The proportionate amount insoluble in a slag would be roughly a maximum at 2% of 0.35 (normal copper content in these slags) = 0.007% Cu, and because all the copper present is not soluble, the error is less than 0.007%, and consequently negligible.

If the statement of Gibb and Philip[12], that copper sulphide is completely soluble in this reagent, is assumed to be correct (and independent tests indicate this to be so), the slight difference represented by Col. 3, Table II, must be either copper dissolved in the iron-sulphide constituent of the matte, and consequently not soluble in $AgNO_3$ solution, or one-half of a proportionate amount of copper oxide present in the matte.

No copper oxide is microscopically evident in the mattes now the subject of discussion, and, moreover, it

[11] It should be understood that the method involves no conclusions as to the chemical form of this suspended copper, but is an empirical method for distinguishing between the two physical forms of suspended and dissolved copper.

[12] *Trans.* A. I. M. E., Vol. 36, p. 665.

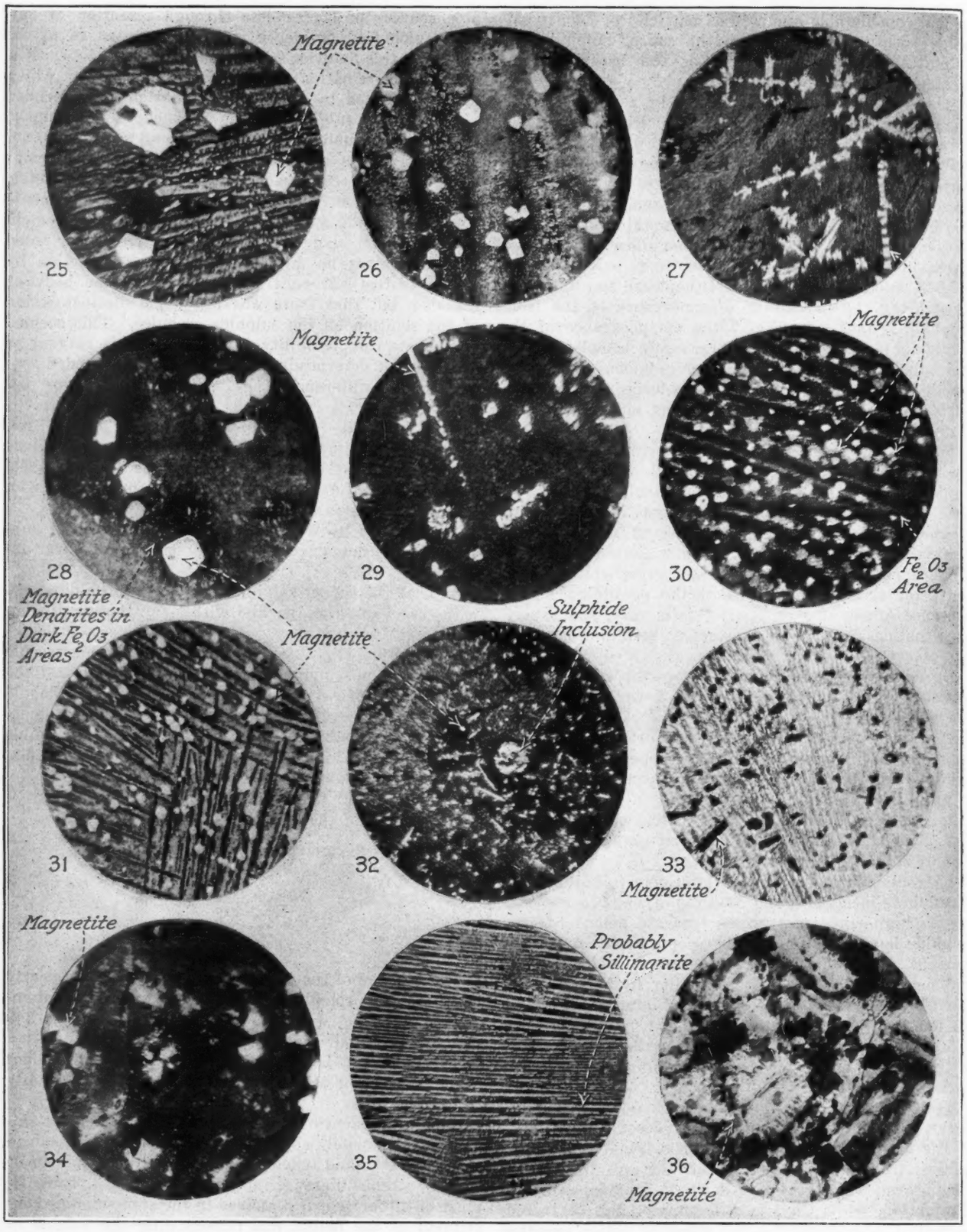


Fig. 25. Reverberatory slag, well crystallized, etched with HF. Clean-cut edges of magnetite and well-defined crystallization of body of slag indicate the formation of former at a period somewhat previous to final solidification. Fig. 26. Reverberatory slag, unetched. Segregated, but not well crystallized. Dark areas adjacent to magnetite probably due to Fe_2O_3. Fig. 27. Reverberatory slag, etched with NaOH. Line formation of crystals indicates formation during solidification. Fig. 28. Reverberatory slag, unetched. An increased magnification of Fig. 26, showing dendrites of magnetite in dark areas surrounding larger crystals. Fig. 29. Limpid reverberatory slag, etched with HF. Minute crystals of magnetite separating on solidification. Fig. 30. Reverberatory slag, etched with HF. Segregated but not well crystallized. Fuzzy edges of magnetite crystals show final separation of Fe_2O_3 at solidification point. Figs. 31 and 33. Reverberatory slag. Fig. 31, a polished specimen etched with HF, should be compared to Fig. 33, a thin, transparent section of the same material. The white magnetite shown by reflected light has become black and opaque in thin section of Fig. 33. Fig. 32. Limpid reverberatory slag, etched with HF. The exceedingly minute crystals of magnetite should be compared to well-developed ones of Figs. 25, 26, and 28. Fig. 34. Reverberatory slag, etched with NaOH. Increased magnification of No. 30. Fig. 35. Blast-furnace slag, well crystallized, etched with HF. Structure well indicated in columnar crystals, which may be alumina or silicate. Note absence of magnetite. Fig 36. Converter slag, first skim, heat tinted.

is doubtful whether it could exist in the presence of the sulphide, so that one is forced to conclude that the solubility of the copper in the iron-sulphide constituent is roughly less than 2% in a 35% matte. The application of the silver-nitrate method is one of direct determination of the amount of copper dissolved by the weak neutral solution present in excess, and in the absence of metallic iron. To insure the latter condition, all samples were pulverized in porcelain. Table III shows the results obtained on some representative blast-furnace and reverberatory slags.

TABLE III. SOLUBILITY OF BLAST-FURNACE AND REVERBERATORY SLAGS IN $AgNO_3$ SOLUTION

Sample	Slags	Per Cent. Cu	Per Cent. Cu Sol. in $AgNO_3$	Difference	Deviation from Mean	Per Cent. Total Cu Sol.
1	Blast-furnace (1a)	0.343	0.175	0.166	0.019	51.0
1	Blast-furnace (2b)	0.35	0.20	0.15	0.003	57.1
2	Reverberatory (1)	0.238	0.072	0.166	0.019	30.3
2	Reverberatory (2)	0.25	0.10	0.15	0.003	40.0
3	Blast-furnace (1)	0.359	0.238	0.121	0.026	66.3
3	Blast-furnace (2)	0.35	0.22	0.13	0.017	62.9
4	Blast-furnace (1)	0.295	0.150	0.145	0.002	50.8
4	Blast-furnace (2)	0.30	0.15	0.15	0.003	50.0
	Mean difference				0.147	
	Average deviation from mean difference				0.011	

(a) Iodide copper determination on one sample by C. G. Maier.
(b) Electrolytic check determination on another sample of same specimen, by E. H.

The average analysis of the above slags for the period during which these samples were taken is:

Sample Slag	Sample 1, Blast Furnace	Sample 2, Reverberatory	Sample 3, Blast Furnace	Sample 4 Blast Furnace
SiO_2, %	36	37	37	35
FeO, %	38	42	34	34
CaO, % / MgO, %	7	4.5	16	18
Al_2O_3, %	11	11	9	10

Examination of Table III brings out forcibly a constancy in the amount of dissolved copper as determined in this manner, which is so close as to seem to preclude chance of its being accidental. The natural conclusion is that this fact of practical constancy is a strong indication that the copper invisible under the microscope is present as dissolved sulphide, for there is no reason to suppose a definite maximum solubility so low in amount for oxide forms of copper.

The question of the relative amounts of suspended and dissolved copper sulphide in converter slags is also one of considerable practical interest. Table IV shows typical results of the application of the silver-nitrate method to samples that were taken from various stages of the blow.

TABLE IV. SOLUBILITY OF CONVERTER SLAG IN $AgNO_3$ SOLUTIONS

Sample	Per Cent. Cu	Per Cent. Cu Sol. in $AgNO_3$	Difference	Per Cent. Total Cu Sol.
Converter "A," No. 1 skim	7.48	7.10	0.38	94.9
Converter "A," No. 3 skim	3.37	3.28	0.09	97.4
Converter "A," No. 6 skim	2.95	2.88	0.07	97.6
Converter "B," No. 1 skim	2.23	2.09	0.14	93.8
Converter "B," No. 3 skim	4.05	3.90	0.15	96.4

Even in converter slags containing an appreciable percentage of copper, nearly all of this, down to the limit of a few tenths of 1% (as in the case of blast-furnace and reverbatory slags), is present in the form of sulphide particles, analogous to white metal or copper sulphide-iron sulphide eutectoid. Moreover, Col. 4 shows that, as the blow continues, the proportionate amount of copper in the dissolved form decreases. It is apparent from microscopic evidence and from the silver-nitrate method, that even at the end of the blow it is chiefly iron which has been oxidized and slagged off, without the formation of appreciable amounts of copper silicates, so that the decrease in the dissolved copper may be explained as being due to that copper originally dissolved in the iron-sulphide constituent. If the dissolved copper were present as oxide, an increase instead of a decrease would be expected as the blow continues.

The amount and kind of suspended copper in Group 1 of Table I is therefore microscopically and chemically capable of direct determination. There remains the problem of the identification of the remaining constituents of Groups 2 and 3. There is some evidence of solutions of a colloidal nature in chilled slags, as indicated by the somewhat reticulated structure and cloudy appearance of Figs. 29 and 8, but there is no ready method of identification of colloids in slags, except possibly by means of the ultramicroscope, which was not available for the work now under review. Moreover, even if colloidal particles were present, the task of differentiation between compounds such as Fe_2O_3 and Cu_2S would be difficult. Evidence has been found, however, for distinguishing between the individual constituents of Groups 2 and 3 in Table I.

Part of this evidence is based on the data of Tables V, VI, and VII, showing the effects of certain addition

TABLE V. EFFECT OF FUSING REVERBERATORY SLAG WITH COPPER-BEARING PYRITES

(Cu = 2.11%)

	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Pyrites	0	4.8	11.1	20.0	33.3	50.0
Cu in slag	0.31	0.23	0.21	0.24	0.20	0.21

TABLE VI. EFFECT OF FUSING REVERBERATORY SLAG WITH COPPER-FREE FeS

	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
FeS	0	4.8	11.1	20.0	33.3
Cu in slag	0.31	0.20	0.18	0.17	0.13

TABLE VII. EFFECT OF FUSING REVERBERATORY SLAG WITH CALCIUM SULPHIDE AND PYRITES

	Per Cent.	Per Cent.	Per Cent.	Per Cent
Pyrites	0	11.9	11.1	10.0
CaS	0	4.3	10.0	18.2
Cu in slag	0.31	0.17	0.12	0.10

agents fused with slag samples. For comparative purposes the plotted data shown in the curves in Fig. 40 make the conclusions more evident. The original copper content of this slag (a sample of reverberatory slag which had received special treatment) was 0.31% Cu, but the silver-nitrate test showed 0.09% Cu as suspended sulphide globules, leaving an original dissolved 0.22% of Cu. This is indicated by the dotted line.

The effect of fusing at about 1300° C. with small percentages of pyrite containing 2.11% copper, shown in the upper curve, is to wash out suspended particles, after which, increases in the amount of the copper-containing pyrite, added to the fusions, produce no change in the copper content of the slag. The close concordance of the amount of dissolved copper determined by silver-nitrate solutions, and the residual dissolved copper not reduced further by the additional pyrites, in slags washed free from suspended globules, is strikingly illustrated by the near coincidence of the dotted line and the upper curve, and furnishes an excellent check on the usefulness of the silver-nitrate method as a criterion for determining the amount of dissolved copper. The lack of effect on the dissolved copper by the fusion with pyrites, which might be expected to occur, owing to distribution ratio, is doubtless accounted for by the fact that the pyrite used is already saturated with copper sulphide[13], and involves the supposition that the dissolved copper is present as sulphide. If the cop-

[13]Compare with the statement as to the maximum amount of dissolved copper in iron-sulphide constituent of matte.

per dissolved in the slag were present as oxide, representing some equilibria of the reaction

$$FeS + Cu_2O \rightleftharpoons FeO + Cu_2S$$

then increasing amounts of pyrites should finally accomplish complete sulphidization and result in a decrease of copper in the slag proportionate to the pyrite added and less than the original dissolved copper.

If the dissolved copper, or a part of this, were present as metallic copper, the addition of copper-saturated pyrite should result in the presence of a constant per cent. of residual dissolved copper, differing from and less than the original dissolved copper by the amount of metallic copper present, because such metallic copper would be sulphidized and settled out from the slag already saturated with copper sulphide. The copper content, after adding excess pyrites, is nearly equal to the original dissolved copper, and one must conclude that the dissolved copper present is sulphide.

As corroborative evidence, the second curve (in Fig. 40) shows the effect of adding copper-free iron sulphide (FeS) to the fusions. After the suspended sulphide globules are removed by a small percentage of this iron sulphide, the reduction of copper in the slag becomes greater in proportion to the amount of iron sulphide added. No original copper is present in this added iron sulphide, so that the distribution effect between the slag and the sulphide phase may take place, resulting in the proportional decrease of copper in the slag above mentioned.

The lower curve (in Fig. 40) shows the effect of the addition to the fusions of a constant amount of pyrite with varying amounts of calcium sulphide. Again the percentage of dissolved copper in the slag approaches constancy, but this constant value was at a lower point than with pyrites alone. The saturation of the slag with calcium sulphide has decreased the solubility of the copper sulphide in it, as would be expected because of the common sulphide ion in case both calcium and copper sulphides were dissolved, and the pyrite, which constitutes the copper-bearing portion of the matte, is again saturated with copper, resulting in the ultimate constant residual dissolved copper. Even if all the calcium sulphide became oxidized or slagged, the decrease in the relative percentage of copper is greater than would be caused by the increased mass due to the addition of lime to the charge.

Summing up the evidence for decision regarding the occurrence in slags of the various possible dissolved forms shown in the Groups 2 and 3 (Table I), the following points, may be recapitulated:

1. It is concluded that oxidized copper compounds are absent because:

(a) No definite compounds containing copper oxide have been identified in well-crystallized samples.

(b) The dissolved copper content of all blast furnace and reverberatory slags examined is approximately constant between 0.15 and 0.20% Cu. No reason is evident for such constancy if copper oxide was present.

(c) Behavior with sulphidizing agents does not indicate the dissolved copper to be in a form possible of reaction with them.

2. Metallic copper is not likely to be present because:

(a) The action of sulphidizing agents would prevent its appearance.

3. There is direct evidence of the presence of dissolved copper sulphide because of (a) the absence of sulphidizing action of copper-saturated pyrite; (b) the appearance of the distribution effect with copper-free iron sulphide; (c) the depressing action on the solubility of dissolved copper by another sulphide, which can be explained only by an effect similar to a common ion effect. Sulphur is the only possible common element, and the dissolved copper must, it is evident, be combined with it.

4. Matte as such (consisting of at least two constituents, as in Figs. 1, 2, 3 and 4) is only infrequently seen as larger particles in slag; consequently it seems still less likely to be present in the colloidal state. With regard to dissolved matte, this is at least a two-component system, so that one cannot speak of the solubility of matte as such unless the amounts of each constituent were dissolved in the same proportion as in the original matte, which seems highly improbable.

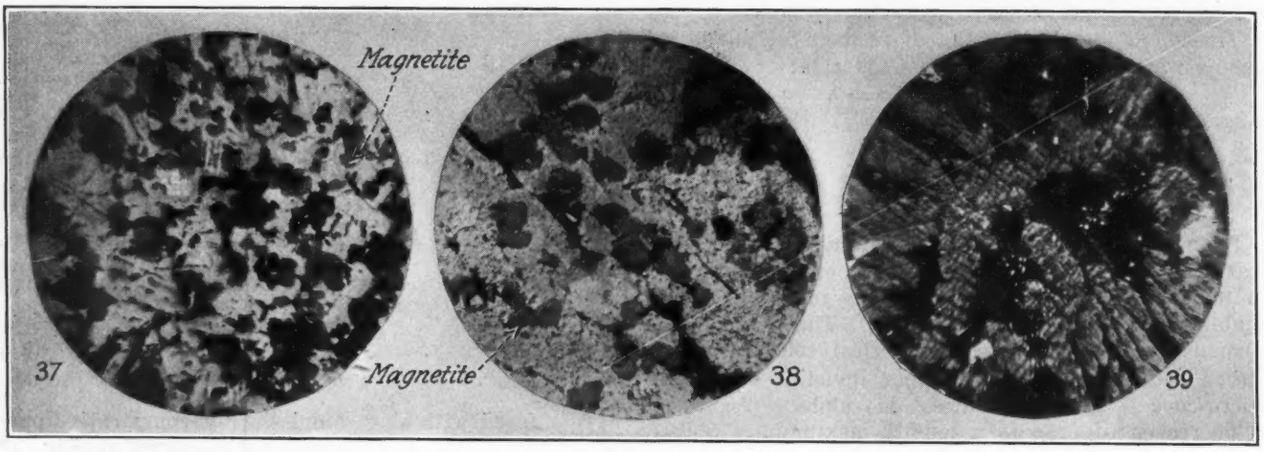


FIG. 37. CONVERTER SLAG, HEAT TINTED. × 100 (200)

FIG. 38. CONVERTER SLAG, LAST SKIM, HEAT TINTED. × 100 (200)

FIG. 39. REVERBERATORY SLAG, REFUSED WITH PYRITES AND CRYSTALLIZED, ETCHED WITH HF

Although one may finally determine the dissolved or colloidally suspended copper constituent of the slag to be sulphide, the ultimate differentiation as to its physical form is more hypothetical, and the indirect evidence relating thereto is somewhat closely bound up with the second part of the experiments here reviewed, which has to do with the mechanism of retention of sulphide globules.

A close examination of Figs. 6 to 24 will serve to indicate that:

1. Iron sulphide as a phase of matte tends to disappear in the sulphide globules suspended in slag.

2. There is direct visual evidence of reaction between the sulphide particles and some constituent of the slag.

3. A gas is the apparent result of this reaction; and, being evolved and remaining in contact with the copper sulphide, it acts as a flotation agent.

The iron sulphide disappears, and the gas formed probably contains some of the substance of the same, and can consequently be assumed to be SO_2. The

mechanism of the reaction must therefore be embodied in the equation:

$$FeS + 3Fe_2O_3 = SO_2 + 7FeO.$$

The following evidence is adduced in support of this equation: (a) The disappearance of FeS is a chemical phenomenon; (b) the oxidation of FeS by other substances possibly present is improbable; (c) Fe_2O_3 is present under the conditions of the reaction.

It has already been shown that one of the resultant products must be expected. The possibility of the disappearance of the FeS constituent by physical means is indicated in Fig. 6, showing the configuration of an inclosed matte globule. However, it is known that in the completely liquid state there is no separation of the constituents of matte; but that on partial or complete solidification, the two components separate. In the process of solidification there should always be some FeS constituent left in sulphide inclusions, because physical forces of separation will cease to act at this point. In many instances no such inclusions are to be noted, and, consequently, other forces of disintegration of the matte must be assumed.

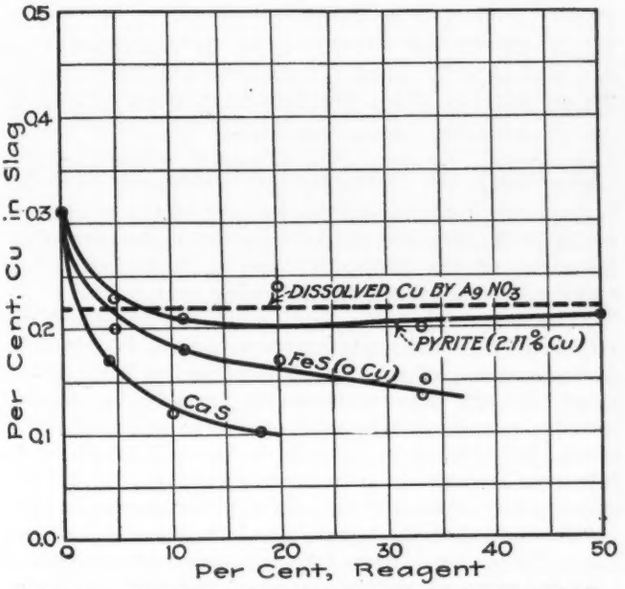


FIG. 40. EFFECT OF FUSING REVERBERATORY SLAG WITH SULPHIDES

The mere presence of gas bubbles as a reaction product, noted in some chilled samples, is in itself evidence of chemical reaction. Other substances which might react with iron sulphide are FeO, air, or carbon dioxide. Of these, FeO is precluded from consideration because the reaction product should be metallic iron, which has not been found in slags examined, although it might occur under certain conditions. Concerning air or carbon dioxide, there is no doubt that these must be the ultimate oxidizing agents. The oxidizing action still goes on in fused slags removed from the furnace, in their interior, or at the bottom of the material, and it seems more probable that some substance, other than dissolved or occluded gas, is directly responsible. Moreover, the reaction products, if air were the agent, should involve the presence of metallic copper, which is unusual.

The occurrence of Fe_2O_3 varies with the presence of magnetite, and the figures from 21 to 39 inclusive show various classes, which may be generalized as follows:

1. *Slags showing no crystals of magnetite.*—To this class belong all blast-furnace slags so far examined.

2. *Slags showing the formation of magnetite crystals during solidification.*—Most reverberatory slags show crystals of these types, which can be recognized because of:
   (a) Formation of crystals in rows, which is only possible if formed at the solidification point.
   (b) Skeletal or dendritic crystals, and minute crystals near larger well-developed ones, indicating later development.

3. *Slags showing well-developed crystals,* without dentrites, and consequently formed during a period of well-fused condition. Converter slags are representative of this type.

Fig. 27 is an excellent illustration of line formation. Figs. 28 and 32 show minute crystals and dendrites. If, therefore, magnetite crystals may be formed during the process of solidification, it follows that Fe_2O_3 must have been present in the magma. Fig. 28, moreover, shows dark areas surrounding magnetite crystals. On disintegration of such a sample of slag by fused caustic potash, magnetite crystals, surrounded by partly decomposed silicates containing Fe_2O_3, are clearly visible.

The question may be asked why the blast-furnace slags examined in the course of the experiments here detailed, which have not shown magnetite crystals, should also show flotation, although the tests have not proved the presence of ferric iron or observed magnetite. To this extent the evidence so far obtained is inconclusive, but re-fusion experiments show that magnetite does form when a strictly reducing atmosphere is not maintained during fusion of blast-furnace slags, and it may be possible that, in the more thoroughly mixed slags of this type, the reaction is sufficiently rapid to prevent the accumulation of ferric iron. Moreover, magnetite actually may have been formed, but may have nearly completely settled out because of its high density.

Conclusions and Possibilities of the Work

It seems reasonably certain that in the samples of slag examined, which are representative of the present practice of matte smelting at the Phelps Dodge properties, little or no oxide copper is present in either blast furnace, reverberatory, or converter slags. Naturally, no conclusion can be drawn regarding all slags, and those from oxide smelting or the production of high-grade mattes should be excepted, but there is strong evidence that sulphide copper is the usual constituent for the conditions under which these slags were produced.

Of this sulphide copper a portion is dissolved. The remainder consists of sulphide globules not characteristic of matte, but rather of white metal or matte free from iron sulphide. Consequently, improvement in settling practice, so long as present slag composition is maintained, cannot be expected to reduce the copper in slags below a certain minimum percentage (in the specific cases under discussion, 0.15 to 0.20%). Recovery of a part of this dissolved copper would require change in slag composition, or the addition of reagents capable of changing the solubility.

Flotative action, as far as the samples examined are concerned, is doubtless responsible for a considerable part of the retained suspended copper, and improved settling alone, under the conditions which cause this gas flotation, cannot be expected to reduce the copper content in the slag down to the theoretically possible amount above 0.15 to 0.20 per cent.

It is reasonably certain that this flotative action is due to the action of Fe_2O_3 on suspended sulphide particles, and that the elimination of such gas-suspended particles can take place only by a reduction or elimina-

tion of the amount of Fe_2O_3. Experiments to achieve this result have been suggested. In other words, one of the main results of this investigation is that it seems desirable to eliminate or reduce, as far as possible, the amount of ferric iron (or magnetite). This will, of course, involve (to produce the same grade of matte) a change in the ratio of sulphur to copper in the charge. For example, the purpose should be to eliminate more than the present amount of sulphur in roasting, preparatory to reverberatory smelting.

It is logical to assume that under the conditions of the experiments, and in the samples of slag examined, the presence of dissolved copper, copper oxides or silicates, or combinations of copper with alumina or iron as aluminates or ferrates, is improbable. Any or all of these, however, may be possible in other slags under suitable conditions.

Summary of Results

The experiments outlined indicate that, in the slags so far examined[14], copper exists in two physical forms, chemically similar:

1. Dissolved copper sulphide:

   In blast-furnace and reverberatory slags usually about 0.15% Cu;

   In converter or mixed slags up to 0.5% Cu.

2. Mechanically suspended particles of sulphide copper varying in composition from matte to Cu_2S + X Cu and in amount equal to total copper less dissolved copper.

The probable main cause of the retention of mechanically suspended particles, aside from inefficient settling and viscosity, is the attachment of gas bubbles, which probably is due to the action of ferric iron in the slag on iron sulphide in the matte.

The dissolved copper sulphide content acts like a saturated solution with respect to fusion with such addition agents as pyrite, iron sulphide, and calcium sulphide.

Appendix

The microscopic methods employed in the examination of slags on which the conclusions set forth herein are based were similar to those usually employed in metallurgical work, and do not require special explanation. Of the etching agents, hydrofluoric and hydrochloric acids were found most satisfactory for silicates; fused acid potassium sulphate gave good results for magnetite, and silver-nitrate, nitric acid, and other solutions were effective for the copper constituents.

Heat tinting in air was found useful for developing the structure, particularly of the iron-containing constituents of slags. Heat tinting in hydrogen failed to disclose oxide copper forms.

The application of neutral silver-nitrate solution for the determination of sulphide globules was a simple analytical procedure. The slag sample was ground to 100 mesh in porcelain. Experiments with finer grinding showed no appreciable increase in the dissolution of copper, thus indicating that the usual practice was sufficient to free all globules. A 1 to 5 gram sample was now weighed into a flask and treated with 1% silver-nitrate solution, sufficient to dissolve twice the total copper content. After frequent shaking and standing for 24 hours, the solution containing copper was filtered off, made acid with H_2SO_4, excess silver precipitated with HCl, and filtered off, the solution evaporated to fumes to get rid of HNO_3 and HCl, and the copper determined electrolytically in the usual way.

In making fusion experiments with pyrites, the assay crucibles used were covered after charging with a layer of calcined charcoal to preserve a reducing atmosphere, and fused at about 1300° C. for a period of about four hours. If a reducing atmosphere is not maintained, the crucibles bubble over, owing to the formation of viscous magnetite-rich films at the surface. After cooling, careful separation of the matte pellet and the lower part of the slag was made to secure a sample of slag as free as possible from matte pellet. The matte in all cases was low in copper, and such error as might be produced by some small inclusion would not be serious.

Magnification of Photomicrographs Not Uniform

The original magnification of the photomicrographs shown in Figs. 1 to 39 could not, for technical publication reasons, be preserved. The following are of identical magnification: (1) About 150 diameters, Figs. 1, 2, 4, 5, 7, 9, 10, 11, 12, 15, 16, 19, 20, 21, 22, 24, 27, 30, 31 and 33; (2) about 35 diameters, Figs. 3, 6 and 17; (3) about 750 diameters, Figs. 8, 25, 28, 29 and 32; (4) about 380 diameters, Figs. 13 and 14.

[14]Blast-furnace, reverberatory, and converter slags from Phelps Dodge Corporation plants.

Geology of Ray and Miami Districts

As a result of his extended study of the copper deposits in the Ray and Miami districts of Arizona, F. L. Ransome, of the Geological Survey, feels justified in making, among others, the following statements:

"The ore, with the exception of one comparatively rich body in which square sets are used, is mined by caving systems of stoping. The orebodies have a marginal position with reference to intrusive masses of granite, granite porphyry, and quartz monzonite porphyry, but the ore occurs both in the schist and in the intrusive granitic or monzonitic porphyry. By far the greater part of the ore is metallized Pinal schist.

"The orebodies are the result of the operation of two general processes—upward or hypogene metallization as a consequence of the intrusion of granitic or monzonitic porphyries, and downward or supergene enrichment by percolating atmospheric water. The hypogene solutions are believed to have been of moderate chemical activity and must have carried copper and sulphur, with probably molybdenum and silicon. Metallization apparently involved no addition of iron to the rocks, the pyrite having been formed by the attack of the sulphur-bearing solutions on the iron already present in the schist and porphyry as oxides and silicates. Permeability of the rocks, permitting the ore-depositing solutions to penetrate them readily, was brought about by fissuring—largely by a multitude of small irregular fissures. This fissuring was doubtless a consequence of the intrusion and solidification of the granite porphyry and quartz monzonite porphyry.

"From the relation of the orebodies to the present surface, and from other considerations, it is concluded that the greater part of the enrichment was effected before the development of the present topography and probably before the eruption of the dacite."

Stand Up and Be Counted. Buy Victory Notes.

Organization in the Settlement Of Industrial Disputes*

By V. EVERIT MACY†

The settlement of labor disputes cannot be attained when conflicting interests display selfish instincts, for each subject to the influence of public opinion and must realize its responsibility to society as a whole. Continuance of increased wages can be made possible only through increased production, and increased profits should be achieved by executive ability and not through control of prices and low wages. In this article, Mr. Macy emphasizes the fact that, after all, the "labor problem is merely a human problem," and unless similar methods are employed in dealing with it as have been found effective with other human problems, maximum production and industrial peace cannot be realized.

IT MAY SEEM like a contradictory statement, but I believe the social unrest prevailing in all countries can be largely attributed to the extension of the public press and the public school system. It is through these two sources of knowledge that the ambitions and desires of people are aroused. The greatest enemy of stabilized conditions is an awakened public opinion, for, until an awakening occurs, no progress can be made. The only cure for the grotesque theories of liberty and the unhealthy unrest now pervading the world is more education, based on broad principles.

We have reached the point in our education where we feel we have only to demand rights and privileges, but, unfortunately, little stress has been laid on the fact that every privilege carries its corresponding obligation and every right its responsibilities. In developing the individual we have failed to impress upon him his social relations to the community. Before industry can be fully developed and disputes reduced to a minimum, the public, the employer, and the employee must be educated along broader lines.

Each individual combines the triple relation of public, employer, and employee. Whether we are engaged in administrative work or in manual labor we are employees of that industry which we serve. When we purchase any article we are indirectly employers, the makers merely acting as our agents. And in all situations not directly involving our personal interests, either as employer or employee, we form what is called the public. In any situation that arises, the interest of the public is paramount, as it represents the greatest number and includes both employers and employees.

Our education has not kept pace with the rapid change in our civilization since the time when each family was a complete productive unit in itself to the present organization of society, where the community is the productive unit. It required war to force us to recognize that the welfare of each member of society is inseparably associated with every other member and that no appreciable number of individuals can take united action without seriously disarranging the normal life of the community. It was then demonstrated that independent selfish action by any group might even endanger the life of the nation. The public must be shown its rights in all industrial disputes, and it cannot longer follow the policy of allowing the economic force of organized groups to settle these disputes. This right places upon the public the corresponding responsibility of seeing that the average citizen is able to maintain a decent standard of living and have a reasonable opportunity for education and leisure, for otherwise the state cannot have desirable citizens.

Employers and employees must come to realize that their first responsibility is to society as a whole and that any interruption in production causes loss to all elements of society. No one's business can therefore longer remain his own, to do with as he chooses. As consumers we must be taught that we have a responsibility to pay a sufficient price for the purchases we make, in order to permit the articles to be produced under proper conditions. It was this principle that caused the passage of the various workmen's compensation acts, and these acts should now be extended to cover well-recognized occupational diseases.

Employers must be content to make their profits by means of their executive ability and not through the paying of low wages or the artificial control of prices. Employees must learn that wages and standards of living can continue to rise only by increased productivity, and if one does not produce in any given period as much in value as the wage received, he is injuring society. There seems to be a general idea that the Government has some mysterious way of meeting deficits, and that if the Government operated all industry the number of hours worked could be much reduced and the pay received largely increased. The fundamental principle that no industry can be run at a deficit indefinitely seems to be lost sight of.

One important teaching should be that human nature is the same and does not change according to one's occupation or financial position, or whether one is an employer or an employee, a brain worker or a manual laborer. To be sure, the opportunity to indulge one's vices or to gratify one's aspirations varies according to one's financial resources, but money neither creates vices nor supplies ambition—both of these qualities are either latent or expressed in the individual character, and are controlled only by education. It cannot be too strongly emphasized that the labor problem is merely another term for the problem of human nature. Labor disputes, like all partisan controversies, cause disputants to feel that justice and all the virtues are on the one side and all vices and privileges on the other, when, in fact, the desire of the average individual in both groups is only for fair play. The sooner we get over the implied inference that labor is something set apart and with different aspirations from the rest of the community, the sooner we will overcome some of our troubles. It is impossible to draw any sharp line as

* Abstracts from an address at the Industrial Conference of the New York Business Publishers' Association, Hotel Astor, New York, on Apr. 11, 1919.

† President of the National Civic Federation.

to what is meant by the term labor, for every occupation, no matter how simple or complex, requires a varying proportion of both manual labor and brain effort.

Possibly those who speak of labor as something with definite limitations and set apart, do so through a survival of the old but discarded theory that labor is a commodity and subject to inflexible laws of supply and demand. This theory has been discarded because it does not recognize the fundamental fact that labor cannot be separated from the individual performing the work. It cannot be shipped from point to point in response to the law of supply and demand unless the individual is also transported. It cannot be stored and reserved for future use, for every day lost to the worker is so much output of labor capital gone forever. The theory that labor is a commodity also fails to recognize that the welfare of the individual worker, as well as that of his family and the state, depends upon the conditions under which the work is performed. In recent years we have discovered that the law of supply and demand is not inflexible, even when applied to material objects. We have seen this law materially modified or suspended through systems of tariffs and by the methods employed by certain trusts.

We need no further proof that human nature is the same, and not only reacts to the same incentives but attempts through the same means to gain its ends, than the similarity of action followed under given conditions by both organized employers and organized employees. For instance, note the common use of such weapons as the boycott, the restriction of output, and the artificial control of prices. We have heard many manufacturers' associations protesting at the "dumping" of foreign-made goods in this country below cost of production. This practice arouses the same resentment among them as union labor feels toward the scab worker who is willing to take his place at a wage below what union labor considers the cost of American standards of living.

Certain practices followed by organized labor have been severely criticised, and in principle cannot be justified, but experience has caused the organization to feel they are necessary as a means of self-protection. As an illustration, it is the natural desire of the employer, when business is active, to train an unlimited number of skilled men to do the required work. The workers have found, however, that when business is slack, the employers use the law of supply and demand, and the fact that there are more men than jobs, as an excuse for reducing wages. This has resulted in the unions establishing regulations for the number of apprentices in their respective crafts. They feel, like many professional men, that after they have spent four years, the usual duration of apprenticeship, in acquiring the skill of their craft, they have acquired a certain vested interest in that craft. Another bone of contention is that in modern industry efficient production is constantly tending toward the greater specialization of each process in industry, so that if a man is put on a particular machine for a long period he obtains little general skill as an all-around mechanic, but does become proficient on his particular machine. If such a man loses his position it is often difficult or impossible for him to find another opportunity to work, for he must find a place in which the same kind of machine is used; otherwise he will sink back into the unskilled labor class. In addition, the specialist naturally receives a lower wage than the skilled mechanic and is used to hold down the wage of the thoroughly trained man. This causes unions to look with disfavor upon specialization until the workman has first acquired sufficient experience to be a real craftsman.

One of the common criticisms against the union policy is that it favors the restriction of output. This charge may be well founded or not, according to the circumstances. Such restrictions are rarely the result of union action, but are brought about by the common consent of the men in a given plant. Many of those who make the charge, however, fail to realize that a man may run 100 yd. at a certain speed, but the greater the distance the slower will be the average speed maintained. No doubt if a workman were only required to perform a certain task for a year, he could turn out a greater average per day than if he were to continue the same occupation for five years, and he could turn out a higher average for five years than he can during the forty or fifty years of the average workman's productive life.

We have many illustrations of the fact that excessive speeding up of work does not always produce the results expected. For instance, many daily riveting records were made in the various yards during the war, but almost invariably the gangs that broke a daily record were so exhausted that at the end of one month their total output was not any greater than that of the gangs that did a fair day's work regularly.

Still another criticism of the policy of organized labor is that it demands the same wage scale for every man, regardless of his ability, and injures the prospect of advancement of the ambitious and highly skilled individual, thus bringing all men to a dead level. The union reply to this criticism is that it merely demands a uniform minimum wage and that the employer is free to recognize unusual skill or ability by paying above the minimum. When one stops to realize that where there are no trade unions the wage of the individual worker depends entirely upon the knowledge or caprice of the foreman, one is not surprised that the unions have established such an arbitrary rule to protect their members from the autocratic acts of a petty man. I have seen payrolls in which members of the same craft were rated at a difference of 1c. an hour, the wage paid running all the way from 35 to 68c. per hour. The greatest efficiency engineer in the world, or the wisest foreman, would find it difficult to convince any fair-minded person that he could distinguish a difference in value of 8c. a day between the work of each one of 33 men. It must be remembered that the duty of the foreman is to keep down the cost of production in his particular department. I believe that this unfortunate tendency upon the part of organized labor to recognize only one degree of skill would never have developed to the same extent if the interests of the members had been protected by some method for a fair hearing of individual grievances.

It is of the utmost importance for the peaceful and productive development of industry that both employers and employees should be thoroughly organized, in order that trade agreements may be worked out between them. Before this can be successfully accomplished, however, employers must place in the hands of broad-minded, experienced men the responsibility of formulating and carrying out their labor policies. Such men might be called labor advisers, administrators, or

engineers. A group of such men representing the manufacturers of an industry should meet with the international presidents of the unions employed and in conference reach an agreement covering the questions of wages and hours for the entire industry or for districts. Local boards, on which the employers and employees should have equal representation, should then be set up for the purpose of establishing local, or district, working conditions and for the interpretation of the detailed application of the wage scale to individual plants.

In each plant of any size there should be a labor adviser, or engineer, and the workers in each craft employed in the plant should elect a committee from their number to represent their craft. The chairman of this craft committee should be a member of a general shop committee, to be composed of the various craft chairmen.

The above plan is given merely as an example of a method that proved successful in maintaining peace in the shipyards during the war. For a period of a year and five months there was practically no interruption of work in the shipyards due to industrial disputes, notwithstanding the fact that during this period the number of men employed quadrupled, with all the complications that such an abnormal increase naturally involved. The advantages of the plan suggested are, first, that the fundamental questions of wages and hours are taken out of the hands of local foremen and local labor leaders and placed under the control of responsible representatives of the employers and national labor leaders. In other words, such matters are thus decided by men of wide knowledge and experience instead of by men of limited vision and local experience. In dealing with labor questions for many years, I have found that nine-tenths of the difficulties start in the arbitrary actions of some petty official of the company or of the local union, and as soon as the question was taken up with the responsible executives of either side, the matter could be quickly and satisfactorily adjusted, unless the prestige and discipline of either party had become too much involved by the action of their respective subordinates.

Another important advantage is that, by determining a uniform minimum-wage scale for the entire industry or district, the success of a firm is then dependent upon the managerial ability of its officials. There is a wide scope for such ability, as shown by the fact that with a uniform wage scale in all the shipyards on the Atlantic Coast, the cost per ton produced varied over 100%. This method of fixing wages protects the well-managed and fair-minded employer from the competition of those willing to make their profits out of underpaying their workers. Profits are not determined by the wage paid, but by the unit cost of the article produced, and the unit cost is 90% a question of managerial ability. Good management always develops a high *esprit de corps* among the workers and attracts the most highly skilled craftsmen to the plant.

The local or district boards to be set up should be given a free hand, with full authority to decide all questions except the changing of the wage scale or the number of hours to be worked. During the last two years I have attended many conferences between employers' organizations and representatives of labor, looking toward the establishment of such boards. These conferences have all had the same history, namely, that at the first session both sides had innumerable limitations or conditions that they wanted included in the agreement and which they thought were necessary to protect their interests. At each succeeding conference these limitations were reduced in number, until finally it was usually decided that a board should be established with unlimited power to determine any question that arose, without restrictions. By leaving to these boards all questions except wages and hours, sufficient flexibility is provided to meet what are in reality purely local or individual plant conditions. In the past, far too much power has been left in the hands of petty foremen and petty local labor leaders.

The main purpose in providing for craft and shop committees is that through these committees grievances can be immediately taken up and settled. Delay in obtaining an impartial hearing for a real or supposed grievance is one of the most prolific causes of labor trouble, and it makes little difference whether the cause for complaint is real or imaginery. Another advantage of these committees is that they develop a sense of responsibility among the men. All individual disputes, or those involving a single craft, can be settled within that craft, without being brought to the attention of other employees not affected, while the general shop committee is in a position to take care of all questions involving more than one craft or the entire plant. Appeals from the decisions of the general shop committee or craft committees should be taken to the district board for final decision.

The great advantage of such a method of handling labor problems is that it is essential, in order to obtain increased productivity, that the employers should be able to present to the workers the limitations and problems under which the industry is conducted, and that the workers should understand their individual relation to the process and that of the industry to the community and other industries. At the same time, the employer can gain a more accurate knowledge of the conditions under which the work is conducted in his own plant. Frequently, by listening to the suggestions made by the workers, he can obtain suggestions that result in the lowering of the costs of production. It is surprising to find, even in the best-managed companies, how little the executive heads know of detailed conditions that seriously hamper the production of the workers.

I wish especially to emphasize the fact that the establishment of shop committees must in no way be taken as an alternative or as a counter weapon against agreements with the regularly constituted trade unions, for no plant committee can make agreements covering competing firms, nor do they have the responsibility of an organization behind them. Above all, they cannot have the advantage of being guided and controlled by men of national experience.

The presidents of the international unions are oftentimes better informed as to the national situation in their industry than many of the employers. This is not unnatural, as the time and thought of the most large employers of necessity must be given to the many problems in their own plants. The national labor leaders, on the other hand, are constantly hearing from thousands of agents of conditions and problems in all parts of the continent.

The establishment of mere machinery to settle any dispute cannot, however, take away the responsibility

of the individual. Peace cannot be maintained in industry by both sides organizing merely for defensive purposes, any more than international peace can be secured by the maintenance of standing armies. We are learning that international peace can be secured only through the just consideration and discussion of the rights of each nation, and the same coöperative spirit must exist in industry.

The first lesson to be learned before modern civilization was possible was that the rights and obligations of the individual had to be subordinated to the public welfare. Why should we longer hesitate to apply the same methods to an aggregation of individuals who are associated in industry? Force settles nothing, whether it is applied in the case of individuals, to an industry, or a nation. Unorganized action, based on the selfish interests of the individual, or locality, merely produces such anarchy as now exists in Russia.

The time has arrived when each individual must take a stand, either for law or organized orderly development, or for the use of force and anarchy. Arbitrary, reactionary employers are as dangerous to society as revolutionary labor agitators. Must we suffer further catastrophes before adopting organized, lawful methods of dealing with all human problems?

Thermit Repairs to a Rock Crusher

An example of the conspicuous part which is being played by Thermit welding in restoring to operation many types of heavy steel mechanical equipment used in the mining industry, such as broken pitmans of rock-crushing machines, mining locomotive frames and side rods, mine-hoist drum shafts, hubs of mine fans, flywheels and numerous other parts of machinery, is afforded by a series of three successful repairs on the broken eccentric bearings of two cast-steel pitmans of a large rock crusher used by the Casparis Stone Co., Havre de Grace, Maryland.

The Principles of Thermit Operation

To those who are not familiar with the Thermit process, it may be said in introduction that Thermit is a mixture of aluminum and iron oxide. This mixture can be ignited by means of special ignition powder, and on reaction produces superheated liquid steel and slag (aluminum oxide), at a temperature of approximately 5000° F. This Thermit steel is sufficiently hot to melt and dissolve any metal with which it comes in contact, and amalgamates with it to form a solid, homogeneous mass when cool.

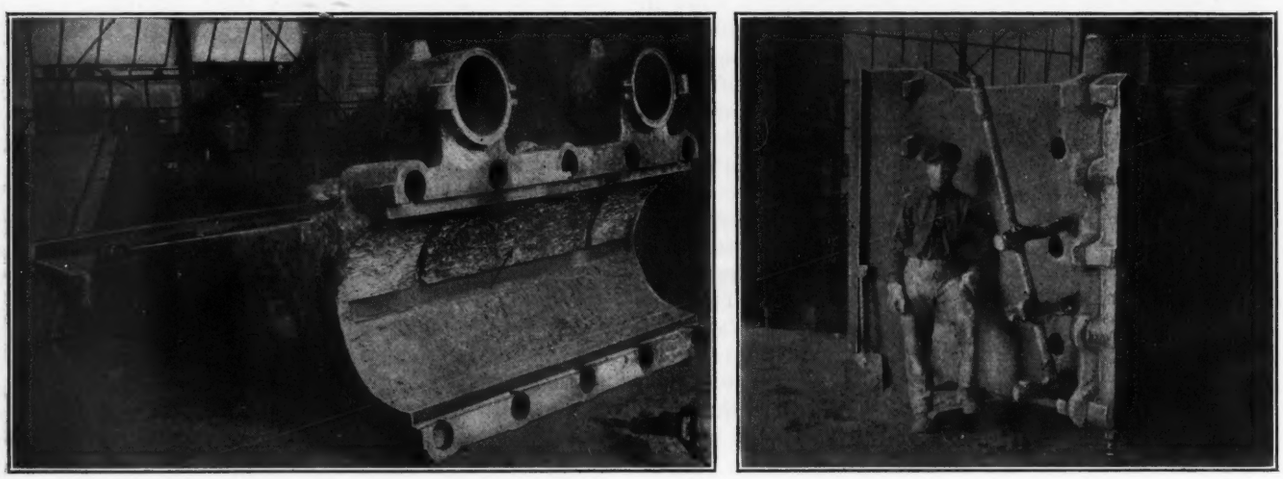
Two breaks occurred about a year ago in practically similar positions in the first pitman of the Casparis crusher. These were successfully welded and the section was delivered to the owner. Before the delivery of the first pitman, however, a part of the eccentric bearing of a second pitman in use at the plant broke off, leaving a fractured surface extending longitudinally through the eccentric bearing, measuring 6 ft. 2 in. in length and averaging about 7 in. in thickness. A mechanical repair was first attempted on the new break, but this failed after only a few days of service, and the casting was then shipped to the Jersey City repair factory of the Metal and Thermit Corporation.

In each of the three welds the method of making the repair was practically the same. The broken sections in each case were lined up with each other and a gap of about 3 in. was cut out between sections with the oxyacetylene flame, to allow for contraction of the weld in cooling.

Manner of Preparing and Placing the Mold Box

The parts were then ready for the application of yellow wax to form a pattern. The wax was warmed until plastic, filled into the gap between sections, and shaped around the parts adjacent to the break, in the form of a collar. In the third weld 90 lb. of wax was used. After having formed the wax pattern, a huge mold box was constructed around the fracture, consisting of a sheet-iron box containing molding material. The material which was to come in contact with the Thermit steel was made of one part fire clay, one part ground fire brick and one part fire sand.

During the filling up of the mold box the molding material was carefully rammed down. Six wooden patterns were inserted horizontally in the mold in the proper position to supply openings for the preheating gates. A cylindrical-shaped wooden pattern directly above the wax pattern formed the space later necessary for the Thermit steel riser to occupy. It should be explained that the function of a riser is to hold a supply of steel which will remain liquid for a con-



THERMIT WELDING ON A ROCK CRUSHER

Photograph at left shows the second weld trimmed and ready for shipment; right shows the third weld, pouring gate, and riser after dismantling mold box

siderable length of time and take care of all shrinkage, so that, when a pipe is formed through shrinkage, this pipe will appear in the riser and not in the weld. The riser also acts as a depositary for loose sand and other foreign matter which may be washed into it by the Thermit steel in passing through the mold, and prevents this material from clogging in the weld. A section of pipe extending diagonally upward from the bottom of the break served effectually as a pattern for the pouring gate.

After the mold box was rammed up, the pipe and wooden patterns were removed, and preheating of the section was begun, for the purpose of drying the mold and bringing the sections to a good heat, before pouring the Thermit steel. This preheating was done by means of a double-burner gasolene compressed-air preheater. In the case of the third weld of the pitmans, the preheating was started at 4 a.m. The first 1½ hours of preheating were required to burn all the wax out of the mold.

Particular interest attaches to this repair, because an extra large automatic crucible, having a capacity for 2000 lb. of Thermit and of somewhat different design from the standard crucibles employed in this welding method, was used experimentally for the first time. The crucible was filled up almost to its total capacity, 1750 lb. of Thermit being used.

When everything was ready for the reaction, a small amount of special ignition powder was placed on the Thermit in the crucible, and this powder was ignited by means of a red-hot iron. The intense heat thus generated started the reaction.

After allowing one minute for the reaction to complete itself, the tapping pin in the base of the crucible was tapped upward by means of a long bar, and the liquid Thermit steel allowed to run out into the mold.

In spite of the enormous amount of Thermit formed in one crucible, the reaction and pour was accomplished with entire success, forming a perfect weld of strength just as great as, if not greater than, any other part of the pitman.

An accompanying illustration shows the arrangement of gates and riser, as indicated by the excess metal present after the mold box was finally removed after cooling.

Financing Foreign Enterprise

The purpose of the Foreign Bond and Share Corporation, which has just been formed, is to finance public and private enterprises in Central and South America, the Far East, Europe, and other parts of the world. It will also sell to American investors either the debentures of the corporation, which will be covered by the deposit of the securities of these foreign companies, or the foreign securities themselves. It is the intention to reach all classes of investors in the United States.

The organizers of this corporation include private banking firms and some of the strongest financial institutions throughout the United States. Among them are Brown Brothers & Co., J. & W. Seligman & Co., Guaranty Trust Co., Chase Securities Corporation, Central Union Trust Co., Columbia Trust Co., Hayden, Stone & Co.—all of New York; First National Corporation of Boston; Hibernia Bank and Trust Co., New Orleans; First Trust and Savings Co., Cleveland; Anglo & London Paris National Bank, San Francisco; Mercantile Trust Co., Mississippi Valley Trust Co., and interests associated with National Bank of Commerce—all of St. Louis; and the Central Trust Co. of Chicago.

A number of the subscribers of the Foreign Bond and Share Corporation are now actively identified with the Asia Banking Corporation, Mercantile Bank of the Americas, the American Foreign Banking Corporation, Banco Mercantile Americano del Cuba, the China & Japan Trading Co., and other American financial institutions which have branches in many parts of the world. For this reason, the new corporation is particularly well qualified to develop American trade, and to pass upon the value and to oversee the management of enterprises which it finances.

Owing to the war, the export trade of the United States has expanded enormously, and the same cause has been responsible for the creation in America of the greatest merchant fleet in the world. Neither, however, will avail the American people unless they are willing to invest some of their capital in the foreign countries to which the American merchant fleet sails and to which American merchandise is carried.

Latin-American and Asiatic and other countries which are undeveloped will buy merchandise from the nation which places capital at their disposal. It is in large part the secret of the success of British, German, and French trade in such countries.

As regards the European countries, they now owe the United States such enormous sums that the mere problem of exchange necessitates the taking of foreign securities by the American public in payment for our exports of merchandise to Europe, if such exports are to continue in anything like their present volume.

In the past London has been the great international market for the securities of every government, and of the industries that were among the principal sources of national wealth. British investors always have been large buyers of such securities. The new-found financial position of the United States should result in a similar appreciation on the part of American investors of this factor, which is vital to the future of our foreign commerce.

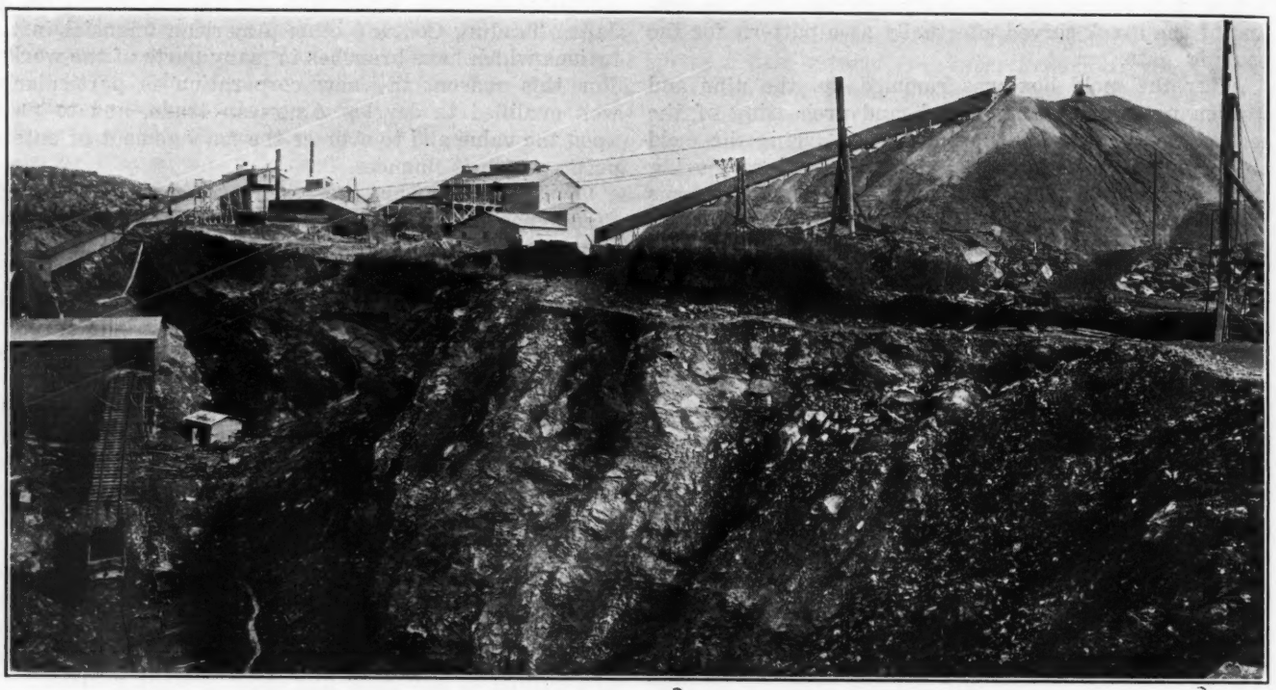
Investment returns in Latin-American and in Asiatic and other countries needing development are higher than in the United States. There is no reason why, under careful supervision, the American investor should not be given the benefit of such attractive rates of investment return, and at the same time have the protection of good security.

England, France, and Germany in the past have done most of the financing necessary for the development of foreign countries, and have reaped the benefits; but, as they are no longer in a position to supply the amount of capital needed for this purpose, Americans must furnish the larger part of it.

Mine Footage Cost of the Boston and Montana Development Co. during 1918 shows an increase of 50% over that in 1917, according to the company's annual report. Work done consisted of 1364 ft. of drifting, crosscutting, and raising. The company railroad from the mine to Divide, on the Oregon Short Lines, is to be completed in June. Work on the 500-ton concentration plant was delayed awaiting railroad completion, although the necessary tests have been made and the kind and character of machinery decided upon.

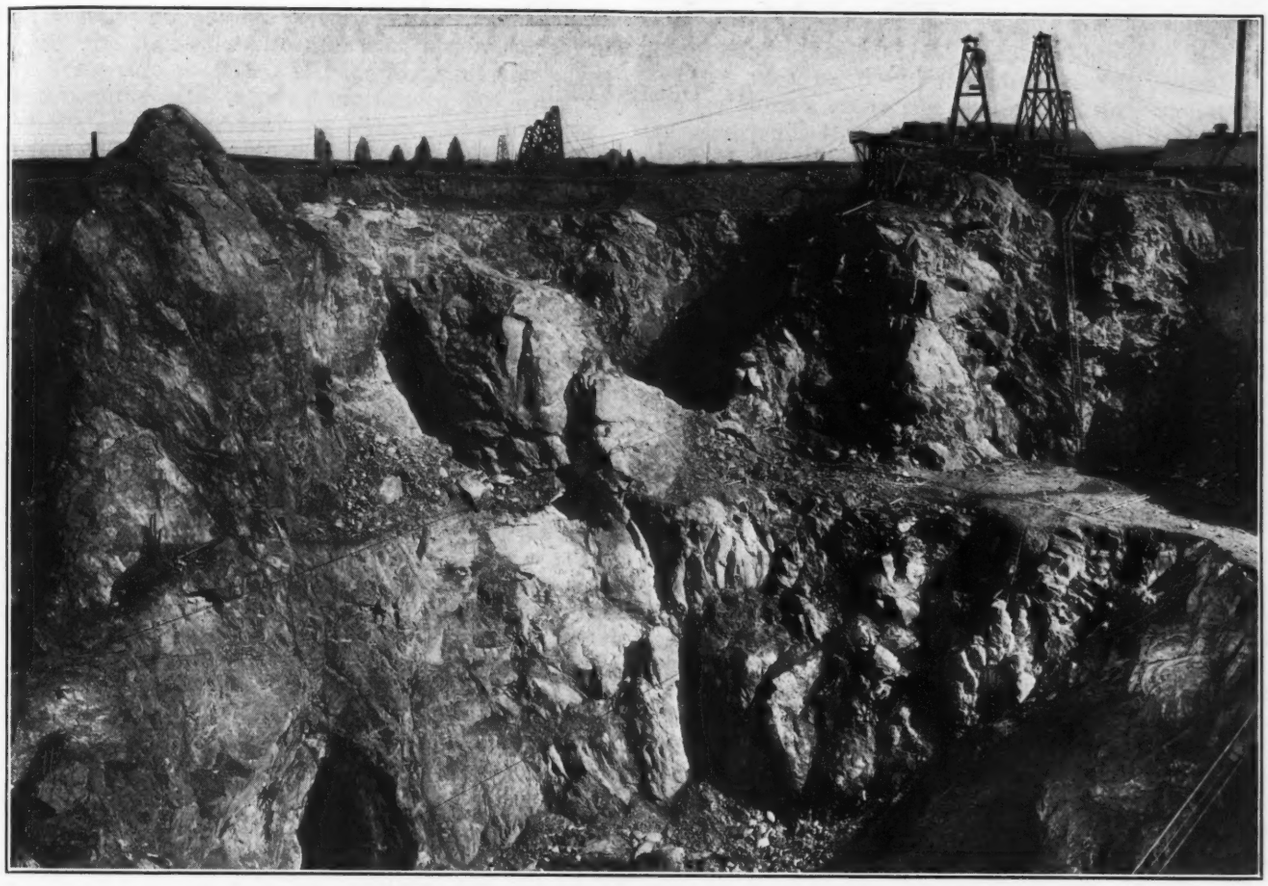
Mobilize Every Available Dollar for the final push. Buy Victory Notes.

Asbestos Deposits of Quebec



PLANT AT EAST BROUGHTON, SHOWING PIT, STORAGE BINS, CRUSHER, MILL, AND DUMPS

ASBESTOS OPEN-CUT MINE, SHOWING TERRACES AND DUMP IN BACKGROUND



OPEN CUT AT THETFORD MINES, SHOWING CABLEWAY STANDARDS

TUNNEL AT ASBESTOS MINE. ASBESTOS ROCK TRANSPORTED FROM PIT TO HOISTING SHAFT

The Mexican Problem

BY "OBSERVER"

HAVING spent 19 years in Mexico and several years in South American republics on professional business, I can corroborate what has been published in recent articles in the *Journal*. I left Mexico only a few months ago, and I know the conditions intimately. One need not exaggerate (as American correspondents felt inclined to do before the revolution); but to exaggerate in an optimistic manner is a most dangerous procedure, as it will lure hundreds of American business men, mine operators, professionals, and skilled laborers to ruin, to separation from their families, and, not unlikely, to death.

If we should abandon our American business interests in Mexico, other nations will take our places. The Spaniards, for instance, would be only too glad to see us retire. The only people that have been and still are the real masters over their former slaves—the anti-Spanish element in Mexico—are of no significance. It is through the Spaniards that we could reach these people, and this is exactly what the Germans have done. They invaded Spain by the thousands, and catered to the likes and dislikes of Spaniards, and soon were patronized in all Spanish countries. The application of justice pure and simple, the inborn principle of the Anglo-Saxon race, does not go far with these people. Flatteries, bowing and much hat raising are necessary first before we can gain any influence over them.

GERMAN METHODS

The Germans applied three distinct forces against the influence of the Americans—they made friends with the Spanish *"haciendados,"* the principal land owners in all these countries; they catered to the Church, and last but not least they advertised themselves in a thousand ways —their schools, methods, discipline, the famous German Kultur, army and organizations. They learned the Spanish language as soon as they entered these countries and married the daughters of "better families." The Germans will be out of the game for some time, but they will remain the bitterest enemies of the English and Americans alike. They will constitute the same jealous and dissent-sowing elements; they will apply new and more secret working forces, unless the new German government shall appoint, as representatives in the diplomatic and consular service, men who are able and willing to work toward a general reconciliation, and who can apply a common-sense policy of a high moral order. But it is not likely that this will happen. The present and perhaps the first next generation of the Huns is still too much afflicted with the Prussian discipline.

The English have endured the greater losses, in comparison with the more numerous American companies in Mexico. They have kept records, but they feel when they go to foreign countries that they do so at their own risk. However, the English government keeps a careful and watchful eye on its nationals.

DIFFICULTIES OF OPERATING IN MEXICO

As to the mining industry in Mexico, it is the opinion of the more cool-headed Americans that it is advisable to keep on working mines and plants that can be operated and which are paying expenses or which can make a profit. To encourage new work or open former mines is not advisable. The spending of new money or the advancing of loans should be avoided. Only a few courts are open; judges will not conduct cases against the government or their own friends; lawyers will not accept lawsuits without demanding fees and expenses in advance, and will proceed only when, after having consuited the "judge," they are certain that the defendant has less influence, although he may have more money. Big and minor cases drag along for years; decisions, even when given, are seldom enforced.

The deplorable financial conditions in Mexico are too well known. Personal safety is only assured by going home in the early hours of the evening. No foreigner accepts a position in the interior of the country, or in places off the railroad, if he can help it. Although the Mexicans spy only on their own political enemies, and murder them in improvised fights, or in the dark of the night in the prison, in the streets or in the country, one is careful what he is talking about to his American or English friends, or acquaintances of other nations. There is a deep mistrust in personal relations and no confidence in business transactions.

GERMAN INFLUENCE AT WORK

It is no secret that the Carranza government was, during the war, decidedly pro-German. It is no secret that it has been anti-American. Whether it will continue to maintain this position can be answered only by the future. The danger of German propaganda has gone; there is no more money for the *caballeros illustros.* The Mexican Ambassador in Berlin, a German *Chileno,* is a red-hot anti-Ally; the one in Vienna much worse, but that fact makes no difference—of cash there will be none.

The Mexicans are entirely dependent on us; we know it and they know it. It behooves the Americans as next neighbors, though sick and tired of all the outrages by bandits and Mexican officials alike, to do some hard thinking about it. Shall we wait until the Republicans are in the saddle, or shall we demand, now, that Carranza has to quit? The "feed the stomach" antidote for revolutions, for preventing the poor from attacking the rich, is as old as the Romans. "Fishes and wines for the *populi* [mob]!" shouted Nero; "Amuse the brutes," says he; and forthwith the Christians were fed to the lions in the circus, and the streets lighted by the burning bodies of the Christian martyrs. As a final joke he burned the city.

The bigger American and English companies operating in Mexico are feeding the peons with corn and selling it at cost price. They move their incoming supplies and outgoing products in their own cars and by their own engines. But that is all they wish to do and can do, often risking the breaking point. The smaller companies and business houses fare worse.

Railroad cars with goods or supplies ordered from the United States are never moved after they have crossed the border line or are loaded in the ports. They are side tracked, and an excuse for congestion is thus purposely created. The buyers wait in vain for the

goods to arrive; they start tracing, appeal to the consuls, to ministers and governors, even to the president. Finally the highest railroad official feels inclined to give preference to such and such a car, if the buyer would pay the extra expense for moving one which is congested among hundreds of others. Sometimes the expense is over 1000 pesos, never less than 500, and the buyer or his agent must look after the moving of the car himself. He must tip the station agent, the engineer, and the brakeman.

The continuous raising of the taxes for export by the Mexican government is an entirely Spanish habit. The Spaniards from early days of the present times not only excluded all foreigners from their colonies for more than 300 years, but after the change came they made the foreigners pay for developing their countries' resources. Only recently the English government called upon the Spanish government to explain the imposition of exorbitant taxes and export duties on everything produced by English capital and English engineers in Spain. Some of the South American republics are trying the same thing all the time. The once Latin system of isolation and home protection is a relic of European and Oriental statesmanship and economic laws of centuries ago. The persistence of it is a sign of inability or unwillingness to understand the policies of the open door, fair trading, and equal international rights.

Americans Not Interested in Politics

I recently read an article about Mexico in the January number of the *North American Magazine*, which can be of interest only to the most intimate student and personal observer of Mexican affairs. Eighty per cent. of the American old-timers in Mexico and other foreigners never bother themselves about Mexican politics or about this or that "chief." I hardly ever looked over Mexican newspapers except for war news. I studied for a while the greatest newspapers in the South—those of the Argentine and of Chile—but gave it up. The flowery language, the steady recurrence of Cæsar, Brutus, Dante, Macchiavelli, Napoleon, and the French Revolution, but the lack of reference to English literature or England's great men in politics, or to the American commonwealth and history, disgusted me.

Although a professional smelting man and interested in other branches of the mining and metallurgical industry, I have no desire to report on the progress or conditions of mining or of metal production in Mexico or in South America. The larger companies and the mining journals are all well posted on these subjects. My personal experiences, my losses both in riches and health during six years of revolution in Mexico (and only on account of the revolution) fall into insignificance compared with the hardships of thousands, nay, millions, of soldiers, civilians, men and women during the war. The gains of the war profiteers, much less those of many foreign business houses in Mexico and in South America where Americans, English, French, Germans and Austrians alike bartered between themselves or together openly, shamefully, blacklist or no blacklist, cannot arouse my envy or my indignation.

I have enjoyed the life in the tropics—the wonderful life in the open. The beautiful colors in the skies down in the countries where the cactus grows. I hear again the *muchissimas gracias* of the brown and dirty Indian with the sombrero in his hand. I am waited on like somebody by a score of *mozos*. People take off their hats, to me; the ladies look at me; some smile, gray hairs or not. There are no blizzards or hot waves, no 20 below zero, or 120 in the shade, no hot rooms, or sleeping porches where one gets covered with dust. One can stretch his legs under the table, sit till midnight, and later, in the club, in the open, in the cafés, listen to agreeable music and shout for a drink—yes, for a drink of any kind.

Peoples have emigrated for many reasons, of course mostly for making a living, a better living in foreign countries. Compulsory military service has driven many out of Europe, and not a few, but many, of the better-class of Englishmen, who detested or could not keep up with social class distinctions at home. It is said that many American soldiers are held back by the fair maidens in *La Belle France* and in England. How many will flee from the United States when nation-wide prohibition and anti-tobacco fiends sweep the country?

I would rather be a big fish in a small pond than a small fish in a big pond—*Viva México, viva Perú, viva Brazil!*

Recent Events in the Mexican Situation

A brief summary, compiled from press accounts, of important events occurring during the last month in relation to the Mexican government, and to the American interests that are coöperating to make clear the status of the Mexican situation, as well as to stimulate action toward the settlement of the present difficulties, is given in the following:

Mar. 15.—Reported that the State of Morelos is completely under control of government troops, after being overrun for 10 years by bands under Emiliano Zapata.

Mar. 17.—State Department advised of capture of J. E. Whetten, an American, and Joseph Bentley, a bishop of the Mormon Church, by Villa forces at Cruices, 50 miles east of Pearson.—Report of a raid on Mar. 1 by 12 armed bandits on oil camps at Tampico, resulting in hanging of camp superintendent, M. Savioz, until unconscious, but he was cut down before life was extinct.—American negro ranch foreman "Bunk" Spencer, and nine Mexican families continue to be held by Villa's men in Chihuahua, despite payment of $5000 for their release.

Mar. 18.—Treasury Department of Mexico announces the Mexican government has no intention of forcing immediate collection of royalties on oil produced in country, during January and February, under Carranza decree of Feb. 18 directing the immediate collection of royalties.

Mar. 19.—Federico Servantes, with 18 men, arrested near Socorro, Tex., while attempting to cross to Mexico to join General Angeles, of the Villa forces.—Eight Mexican cowboys and "Bunk" Spencer, American negro, reported released by Villa's commander, Marin Lopez.—Francisco Villa, with 500 men and 14 wagons filled with sick and wounded, reported seen at Chihuahua City.—Resolutions favoring League of Nations and expressing sympathy with President Wilson introduced in the Mexican Congress on Dec. 13, 1918, were published.

Mar. 20.—Announced that 400 American business men and financiers representing many towns and cities in the Mississippi Valley would visit Mexico on the invitation of President Carranza.—Reported that Mexi-

can diplomatic representative in Paris would not be received by the peace delegates.—Rafael Nieto, acting Minister of Finance of Mexico, in conference with the International Committee of Bankers and J. P. Morgan & Co. A loan for the Mexican government was not negotiated.—Message received from Bishop Bentley, that he and J. E. Whetten, and Albert Tietjen, all Mormons, were released by Villa's forces and are returning.—Fighting between federal cavalry and Villa forces occurred near Ascension, 60 miles south of Columbus, N. M., resulting in a number of Villa's men being killed and others captured.—Announced that airplane patrols would be established along the Mexican border by the U. S. Government when the Army is reorganized on a peace basis.

Mar. 21.—Proposed to eliminate retroactive features of Article 27 of Mexican Constitution, the republic to claim only future discoveries as nation's property.

Mar. 23.—Troops of 8th U. S. Cavalry returned to Marfa, Tex., after pursuit of Mexican bandits, across border, resulting in the recovering of 35 cattle and two horses taken by raiders the previous day. Oscar Wallace, an American ranch farmer residing at Hacienda Encinas, near Progreso, Coahuila, reported attacked by bandits and held prisoner.

Mar. 24.—State Department of U. S. Government advised that the Mexican government issued circular threatening to punish companies and individuals that drill oil wells or perform other petroleum development without permission.

Mar. 25.—Ambassador Fletcher, of the U. S. State Department, conferred with representatives of leading American oil companies in reference to threat of Mexican government to punish drilling of oil wells without permission.—The body of Oscar Wallace, who was recently kidnapped, was found near Progreso, Coahuila, according to advices received in Washington.

Mar. 29.—The Mexican Claims Commission, in session at Mexico City, was flooded with claims against the government, according to advices received in Washington. The number of claims arising from the Madero revolution will amount to about 8000, one third of which will be filed by foreigners.

Mar. 30.—Concessions were granted to Japanese to exploit agricultural lands in Lower California, according to a reported statement of General Amado Aguirre. Japanese Legation in Mexico City denies any official knowledge of the transaction. Washington believes the attitude of Japanese government will not permit Japanese to acquire land in Mexico without sanction of the United States.

Apr. 1.—Troop of 80th U. S. Cavalry, after a raid by Mexican bandits across the Rio Grande, overtook and killed five of the bandits, recovering the horses and cattle which had been stolen.

Apr. 3.—Under Secretary Amado Aguirre, of the Department of Agriculture and Development, denies statement attributed to him that Japanese companies had acquired land in Lower California.—Appeal made for recognition of the belligerency of the Diaz movement in a circular letter received by American consulate at Juarez. U. S. State Department officials said no official notice of the revolutionary movement would be taken, as the government of Mexico has been recognized by the United States.

Apr. 4.—Announcement of the landing of General Aurelio Blanquet on east coast of Mexico to organize the Diaz forces and overthrow the Carranza government.—U. S. Immigration officials announce Mexican border passports regulations are suspended in a zone 40 miles south of the border. Permits may be obtained by American citizens on verbal application.

Apr. 8.—Rafael Nieto, who for the last year has been Secretary of the Treasury, resigned, and Luis Cabrera, former Secretary of the Treasury, has been named. Cabrera is regarded as being antagonistic to the United States.

Apr. 9.—Announced that an investigation had been ordered by U. S. Department of State of the attack on passenger train between Tampico and Monterey by Mexican bandits on Apr. 4, in which J. P. Mennet, an American citizen, was wounded.—Diplomatic advices received in Washington to the effect that Mexican government is returning to the owners more than 400 mining properties in the State of Chihuahua.

Apr. 10.—"The Nation" editorially charges oil interests are attempting to influence American public opinion toward intervention, by charging Carranza with pro-Germanism.—On permission of American authorities, 2,000,000 rounds of 7 mm. rifle cartridges were taken across the border for the use of Mexican government forces.

Apr. 11.—Washington advices announce that an American citizen, Edward E. Morgan, was murdered at Chivela, 47 miles from Salina Cruz, on Apr. 8.—General Emiliano Zapata, of rebel forces, was killed by federal troops, according to announcement of the government.

Apr. 12.—New York Group of American Chamber of Commerce organized to promote trade between United States and Mexico.

Apr. 17.—General Blanquet reported killed by Carranza forces.—E. L. Dufourcq, an American mining engineer, killed by Mexican bandits.

Apr. 23—Acting Foreign Secretary Fernandez declared Mexico never had recognized and never would recognize the Monroe Doctrine.

Apr. 26—Information became known that Villa is concentrating all troops under his control in Chihuahua in attempt to reëstablish a rebel government.—Washington officials believe refusal of France to recognize Alberto J. Parie as Minister from Mexico was caused by protests from French bankers against seizure of French banks in Mexico.—Reported that intimation had been made to Mexico she would not be given a place in the League of Nations unless her policy of dealing with foreign aliens and foreign investors was modified.

Apr. 27—Mexican gunboat captured the American fishing schooner "Cape Horn" in Gulf of Mexico, alleging the smuggling of arms to rebels in Vera Cruz.

Apr. 29—Considerable interest aroused in Washington regarding identity of governments friendly to Mexico that requested Mexican Foreign Office to express an opinion on the recognition of the Monroe Doctrine as announced in official dispatches. Opinion expressed that if such an inquiry were made it probably came from Argentina and Chile.

Iron-Ore Exports From Algeria in 1918 were 782,047 metric tons, as compared with 1,065,512 tons in 1917 and 938,684 tons in 1916, according to *Echo des Mines*. Of the 1918 shipments only 7400 tons went to France, the rest having gone to the United Kingdom.

The New Price Revolution*

By IRWIN G. FISHER†

There are glorious opportunities ahead. For all the years of the war we have neglected producing those things which could not be classed as "war material." Today there are empty shelves everywhere and a world-wide demand. The more rapidly we can increase production and stimulate consumption, the quicker we can speed up the process of exchange and the sooner shall we see the smiling face of Prosperity, waiting just around the corner —prosperity for capital and prosperity for labor.

IT IS INTERESTING to observe that many manufacturers think that prices must come down, including the price of labor; but they are ready to demonstrate to you that their own prices cannot come down, nor can they pay lower wages. Almost everything they buy somehow costs twice as much as before the war, and their labor is twice as dear. They cannot pay their labor less if labor is to meet the increased cost of living. Now, as a matter of fact, when we investigate almost any individual one of the so-called high prices for industrial products we are likely to find that individually it is not high; that is, it is not high relatively to the rest. Our quarrel is with the general level of prices.

Variations in the general price level may be compared to the tides of the sea, and the individual prices may be compared to waves. Individual prices may vary from this general level of prices for specific reasons peculiar to individual industries, just as the height and depth of waves vary from the general level established by the tide. The causes controlling the general price level are as distinct from those controlling individual prices as the causes controlling the tides are distinct from those controlling individual waves.

The general level of prices is dependent upon the volume and rapidity of turnover of the circulating medium in relation to the business to be transacted thereby. If the number of dollars circulated by cash and by check doubles, while the number of goods and services exchanged thereby remains constant, prices will about double.

The great price changes in history have come about in just this manner. The "price revolution" of the sixteenth century came upon Europe as a result of the great influx of gold and silver from the mines of the New World. Europe was flooded with new money. More counters were used than before in effecting exchanges, and prices became "high." People talked then of temporary "inflation," just as they talk of it now. But it was not temporary; it was a new price level.

A similar increase in prices all over the world occurred between 1896 and 1914, following the discovery of the rich gold fields of South Africa, Cripple Creek, and Alaska, the invention of the cyanide process, and the vast extension of the use of bank credit.

Circulating credit—that is, bank deposits subject to check, and banknotes—is a multiple of the banking reserve behind these deposits and notes; and the essence of this reserve is gold. Our present monetary system is an inverted pyramid, gold being the small base and banknotes and deposits being the large superstructure. The superstructure grows even faster than the base. The deposits are the important elements. They are transferred by check from one individual to another; that is, the circulation of checks is really the circulation of deposits.

Thus any increase in the country's gold supply has a multiplied effect. The possible extent of that effect is dependent upon (1) the amount of gold available, and (2) the gold reserve requirements, determining the volume of credit that can be put into circulation based upon the gold. Over a billion dollars in gold has come into this country from abroad since 1914, and a large amount has disappeared from domestic circulation. The gold from both these sources has found its way into the United States Treasury and into bank reserves.

On June 30, 1918, the portion of the gold reserve of the Federal Reserve banking system which supported national bank deposits and Federal Reserve notes was more than three times as large as the gold reserves under the old national banking system on June 30, 1914—$1,786,000,000, compared to $592,000,000. During the same period credit instruments (demand deposits and notes) increased about twofold—from $6,100,000,000 to $11,700,000,000. This increase of credit instruments is typical of the banking situation for the country as a whole, and largely explains the present high level of prices. The increase of gold has been so great, however, that the base has grown faster than the superstructure —which is contrary to the normal tendency.

The ratio of gold to credit has risen from 9.6% to 15.3%. The legal reserve requirements of the present system are such that for 1918 there is an excess of gold above these requirements of more than $700,000,000. The reserve required by law to support the $11,700,000,000 of credit instruments of 1918 is $1,070,000,000. The $700,000,000 of free gold could support an additional superstructure 70% as large as the existing one, which indicates that for the banking of the country as a whole a potential future expansion of 50% is a conservative estimate.

At the present time European goods are not "low priced" (however little the money wages of European labor will buy). Prices in Europe since the war began have risen more than they have in the United States. The price rise has been less the further from the seat of hostilities. It was least in Australia and New Zealand. It was next least in the United States, Canada, and Japan. Then came neutral Europe; then our present Allies; and finally Germany and Russia. Gold tends usually to flow from high-priced countries to low-priced countries, so that until "inflated" European prices fall, gold is not likely to flow thither. Prices are no more likely to fall there than here.

Looking into the still more remote future, there will be in Europe, particularly on the Continent, a vast increase in deposit banking. The need of the govern-

*Extracts from a paper read before a conference of state governors and mayors at the White House on Mar. 3, 1919, and abstracted from a pamphlet which is obtainable from the National Prosperity Campaign headquarters at Room 700, Commodore Hotel, New York City.

†Professor of political economy, Yale University.

ments there for funds during war times hastened the introduction of deposit banking. Money went out of circulation into bank vaults, and there became the basis for circulating credits. This means a new habit which will lead to a great currency expansion. Far-away countries, like India and China, are also learning to use deposit banking. It is as if a new source of gold supply had been discovered. What has been discovered is a new way of using the gold supply. The world, during the course of the war, has thus started, or has hastened, an equivalent of the price revolution of the sixteenth century.

Business men should face the facts. To talk reverently of 1913-14 prices is to speak a dead language today. The buyers of the country, since the armistice, have made an unexampled attack upon prices through their waiting attitude, and yet price recessions have been insignificant. The reason is that we are on a new high-price level, which will be found a stubborn reality. Business men are going to find out that the clever man is not the man who waits, but the one who finds out the new price facts and acts accordingly.

George Ferdinand Becker

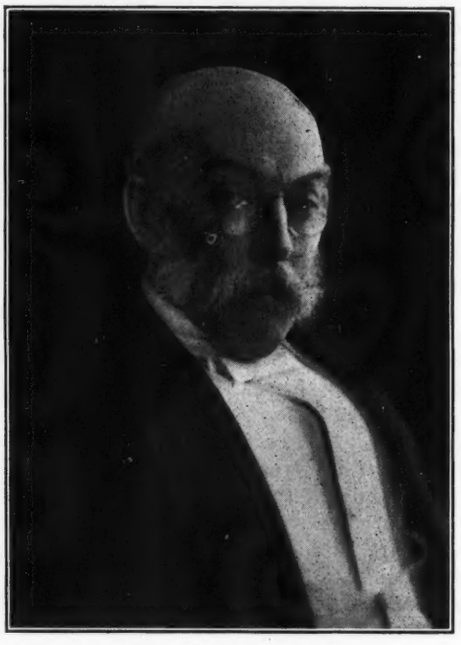
Dr. George Ferdinand Becker, the well-known geologist, died in Washington on Apr. 20, at the age of 72. He was born in New York City and was the son of Alexander Christian Becker, of Denmark, and Sarah Cary Tuckerman Becker, the daughter of the Rev. Joseph Tuckerman, of Boston.

Dr. Becker was the last member of the group of distinguished geologists who in 1879 were associated with Clarence King at the time of the organization of the U. S. Geological Survey. He was a leader in mining geology and geophysics, and for many years had been the chief of the division of chemical and physical research in the Geological Survey, and the investigations under his direction led to the establishment of the geophysical laboratory of the Carnegie Institute, at Washington.

Dr. Becker was a graduate of Harvard, received the degree of doctor of philosophy at Heidelberg, and later was graduated from the Royal School of Mines in Berlin. He was for four years an instructor of mining and metallurgy in the University of California, from which he came to the U. S. Geological Survey. He was one of the pioneers in governmental efforts to guide and encourage the development of the mineral resources of the West. In 1880, when essentially the entire technical staff of the Geological Survey was utilized by the Bureau of the Census in taking the census of mineral production, the statistical work west of the Mississippi River was placed in Dr. Becker's charge. A little later his personal solicitations before committees of Congress were largely responsible for the permanent establishment, under the auspices of the Geological Survey, of the annual statistical canvass of the mineral industry of the country now conducted by the division of mineral resources.

In 1880, also, Dr. Becker began the study of the geology of the famous Comstock silver lode, which, even at that time, had yielded $325,000,000 in bullion and is imperishably associated with some of the most romantic episodes in American mining. The results of this work were published in monographic form in 1882. Becker's atlas of the Comstock Lode was a compilation of all the mine maps that were of interest. It also contained geological maps and sections. For a long time both the monograph and the atlas have been of use to mining engineers on the Comstock as well as serving to set a standard for that period. The summers of 1883 to 1885 were spent in the study of the quicksilver deposits of California, and in connection with these studies Dr. Becker made a visit to the famous old Almaden mine in Spain. He was one of the pioneers in the geological work in the coal and gold fields of southern Alaska, which he visited in 1895.

Dr. Becker's geological observations and studies were not, however, confined to the United States, for in 1896, under the auspices of an English company, he visited



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GEORGE FERDINAND BECKER

the Rand gold fields, South Africa, some of his observations there being later published by the Geological Survey. In 1898 he reported to the Military Governor of the Philippines as geologist and spent 14 months in the islands. Although prevented from accomplishing much in the way of active field work, because of the hostile attitude of the natives, he was able, during that period, to compile a useful review of the geology of the islands as known at that time. In connection with this Philippine service Dr. Becker prepared a special report for President Roosevelt on the desirability of scientific explorations in the Philippine Islands.

Dr. Becker also rendered national service in the Canal Zone as a member of a special committee under the auspices of the National Academy of Sciences, for the purpose of investigating the geologic phases of the engineering problems of the Panama Canal.

Dr. Becker was a member of the National Academy of Sciences, the Washington Academy of Sciences, the American Institute of Mining and Metallurgical Engineers, and the Metropolitan and Chevy Chase clubs. In 1914 he was elected president of the Geological Society of America. He was the author of more than a hundred scientific papers, which cover a wide field in scientific research. Dr. Becker is survived by his widow, Florence Deakins Becker.

Correspondence and Discussion

Improved Conditions in Western Mexico

I have just returned from a trip to the west coast of Mexico, and believe that a letter as to conditions found there might be of interest. The Southern Pacific R.R. is running three through trains a week from Nogales, Sonora, to Acaponeta, Nayarit. The latter is a new state formed from the old territory of Tepic. In general, conditions may be said to be good, especially in Sinaloa. The Yaqui Indians are still giving a considerable amount of trouble in Sonora.

Hardly a week passes but several helpless Mexicans are murdered in outlying villages, so that it is not safe to leave the railroad. Several strong companies are working continuously in this district, but are able to do so only by employing a suitable guard. All trains between Nogales and Esperanza, Sonora, run in daylight only and with a heavy guard.

In Sinaloa a few bandits still operate, but offer no real danger. Conditions are similar to those of prerevolutionary days; and, on the whole, the people appear more prosperous than they did 10 years ago. All, apparently, have benefited from the sale of the large crops of *garbanzos* (chickpeas), which have been exported to Spain during the last year. The people were never better clothed.

Our party left the railroad at Guamuchil, a small station on the Southern Pacific R.R. opposite Mocorito. We traveled muleback inland for three days, and never once felt in the slightest danger. I do not believe that such a journey would be possible in any other state in the republic at this time. During our trip through this country thousands of heads of cattle were noted—an odd but pleasant experience to one who has but recently traveled extensively through Central Mexico, where the sight of a single animal is a rare occurrence. We were well received at all villages en route, especially by the tradesmen, who now herald the arrival of engineering parties as a return to former peaceful conditions.

The Palmerito mines, in the Mocorito district, are working at full capacity. Shortage of wood has temporarily closed the Potrero mill. Grasshoppers during this last season destroyed the crops and pasturage, forcing all wood contractors to leave the district. The Calabacillas and San José de Gracia properties are being worked on a small scale. The latter has only recently been returned to its owners, who are Mexicans, by the government. Needless to say, the mine was badly "gutted" when returned. I was told that the big La Cruz oreshoot at this property had petered out, breaking up as the ledge passed from the andesite into the underlying sedimentaries, just as did the former bonanza shoot which was worked by the old Anglo-Mexicano Co. from 1894 to 1898.

Extensive development work has been started on a new silver mine near Bacubirito, Sinaloa, called Noche Buena. Rumors were heard that the Texas Scotch Co. was considering starting construction work on the new mill at the Rosario mine, at Guadalupe y Calvo, Chihuahua. Extensive work at such an out-of-the-way place is not possible now, because all supplies must come from Parral, and an attempt to start the project at the present time would probably only end in a repetition of the fiasco of 1911. Several Americans remained at La Cumbre de San Manuel, Chihuahua, during the entire revolution. They are now operating a small mill at this camp. Further south, conditions are said to be good as far as the state line of Nayarit. It is generally conceded that conditions in this state are worse than in any other part of the republic.

Mining operations on the west coast of Mexico are still seriously affected by numerous new labor laws, as a result of constant interference by the many petty officials in office, and especially by the lack of banking facilities. Except for federal business, Sonora uses only United States money. Sinaloa is still endeavoring to use the peso, but there is not enough actual money in the district to carry on business. United States money, other than gold coin, is discounted about 20% in Sinaloa. Sonora took to the dollar like a duck to water, and without bothering to change the price tag. Prices are now in dollars that were formerly expressed in pesos.

Faith in the west coast is evidenced by the large number of Americans entering this section since the close of the Great War. In reality a small boom is taking place. If no setback occurs, the west coast will soon be its old self. Conditions are unquestionably improved and are better than I had any hope of finding.

Denver, Colo., Apr. 13, 1919. BENNETT R. BATES.

Revision of Mining Laws

I note in the *Journal* of Apr. 26 that your Washington correspondent advises that another attempt to revise the mining laws will be made at the forthcoming session of Congress; and, further, he states that: "The real truth of the situation, however, is admitted to be lack of information as to what the mining industry wants. No comprehensive effort ever has been made to gather data on the subject."

Perhaps this is the impression that exists with some of the newer members of Congress, but it is far from being correct. The subject has been under discussion by individuals and associations for many years. Among the leaders of this discussion, H. V. Winchell, president of the American Institute of Mining and Metallurgical Engineers, has taken a most prominent part. In 1913, Mr. Winchell, as chairman of the committee on the revision of the mining laws of the United States, appointed by the Mining and Metallurgical Society of America, corresponded with a large number of American mining men in an attempt to learn their views respecting existing laws. As a result of Mr. Winchell's work, the Mining and Metallurgical Society finally issued a ballot asking for a vote on ten specific questions. The results of this ballot were tabulated in the March, 1914, Bulletin of the society. The summary there given indicates decided views and close agreement on several of the questions that were submitted. Work on this

subject was continued by the society, and in 1915 every mining association in the United States was asked to give these questions consideration, and they were also referred to many mining companies.

In December, 1916, a meeting was called in Washington which was attended by representatives from many associations and many mines, and their views were placed before Congressmen and Senators. The proceedings of that meeting were published in Senate Document No. 233, 1st Session, 64th Congress.

Early in 1917 the Senate and House committees on Mines and Mining held numerous sessions at which mining laws were fully discussed by a large number of competent witnesses. These hearings have all been published in the reports of the committees.

It was the opinion of nearly all witnesses examined that the subject was so broad that no revision should be attempted until a competent commission had been appointed and taken evidence in all parts of the country that would be affected by changes in the law. Such a committee should then report its findings to Congress in the form of a bill, to be passed, modified, or rejected as Congress saw fit.

The commission plan was not acted upon favorably, owing largely to the fact that members of Congress felt that the mining men should get together, formulate such laws as they wished to have passed, and then submit them to Congress for adoption or rejection. The expense of the latter method, and the impossibility of securing a thoroughly representative committee that could give sufficient time to the matter, prevented its adoption.

Practically all data that mining men can carry to Washington are already there and on file with the committees on Mines and Mining. The need for revision of the United States mining laws is admitted. What remains to be done is the appointment of some properly constituted body to take further testimony in the various districts affected and then draw up such modification of existing laws as may seem proper. This can be done only through the appointment of such a commission by Congress. F. F. SHARPLESS.

New York, Apr. 30, 1919.

Employment for Engineers

You have recently made mention editorially of the assistance which the well-established employment agencies can give returning soldiers and sailors in securing work. We should like to take this opportunity of advising all engineers being released from military duty that the services of this agency are entirely open to them, without any registration fee.

For 16 years we have been securing mining and metallurgical engineers for mining companies, as well as civil, electrical, and mechanical engineers for the irrigation, power development, railroad, and construction companies. To maintain this service, it is necessary for us to make our regular charge, even for the soldiers and sailors, upon the securing of a position, but we understand that it is employment that they want, whether they pay for it or not. To men coming out of military service there is no initial registration charge. BUSINESS MEN'S CLEARING HOUSE,
S. Sergeant Newbury,
President.

Denver, Colo., Apr. 14, 1919.

More About Spanish

The other day a credit was cabled from South America through a famous bank which has recently entered the export field. The credit read: "Pay Mark R. Lamb two thousand dollars value canvas mas shipping charges," and the bank cabled to Bolivia to ascertain what kind of shipping charges these were, and it was advised that "mas" meant "moreover" or "besides."

Another credit covered a shipment of rails and read: "Pay Mark R. Lamb three thousand dollars valor rails." Upon presentation of documents for the shipment of steel rails, the bank insisted that the shipment covered "valor" rails instead of steel rails.

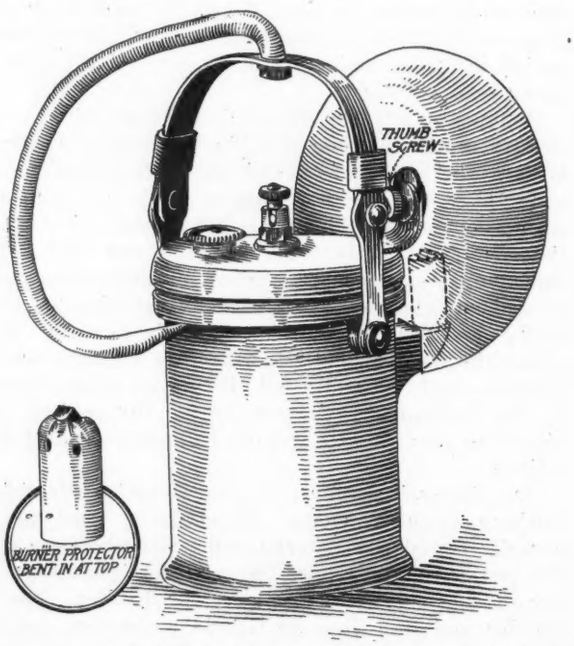
This will prove conclusively to your correspondent, "George Washington," that a knowledge of Spanish is not necessary even in the export game.

New York, Apr. 22, 1919. MARK R. LAMB.

Suggested Improvements for a Miner's Carbide Lamp

An article, "Improving a Miner's Carbide Lamp," appearing in the *Journal* of Feb. 8, 1919, suggests certain changes that may be made in a "Wolf" carbide lamp. The following ideas in this connection may be of interest:

Instead of a leather thong for holding the reflector, why not use a small setscrew, as shown in the illustration? If the metal tip protector is bent in, so that the burner will not pass through, and then firmly pushed down, it prevents a possible loss of the burner tip and also holds it firmly in place. One may secure practically the same effect provided by means of the improved handle by bending the handle furnished with the lamp, and springing it into place with the point under the rim of the carbide container. Such changes, which facilitate the handling of these lamps underground, will be appreciated. ENGINEER.



SUGGESTED CHANGES THAT MAY BE MADE FOR THE IMPROVEMENT OF CARBIDE LAMPS

Tyrone, N. M., Feb. 11, 1919.

Ore Dressing and Metallurgy

The handling of froth that obstinately refuses to "die" constitutes a problem in many phases of wet-chemical and flotation work. A method of removal of such froth from the overflow of a Dorr thickener which has proved satisfactory, and which yielded a product of higher lead content than the more easily settled concentrate, is described.

Improved methods of manufacture have resulted in the production of a number of handy and comparatively cheap materials for construction work. Expanded metal is one of these. It will find wide application around mills and reduction plants.

Opinions have differed as to the amount of gold that may be volatilized during metallurgical operations, and definite and conclusive data have been lacking. The results of a scientific investigation and the conclusions evolved by an authority on the subject, which are reprinted herewith, will be appreciated.

A new process, which is specially adapted for the treatment of mixed ores containing copper, both in the form of sulphide and as cuprite, and, possibly, in other oxidized minerals, is described. The process is essentially a combination of leaching with a dilute acid solution and flotation, and the two methods of application are described.

Froth Removal From Dorr Thickener

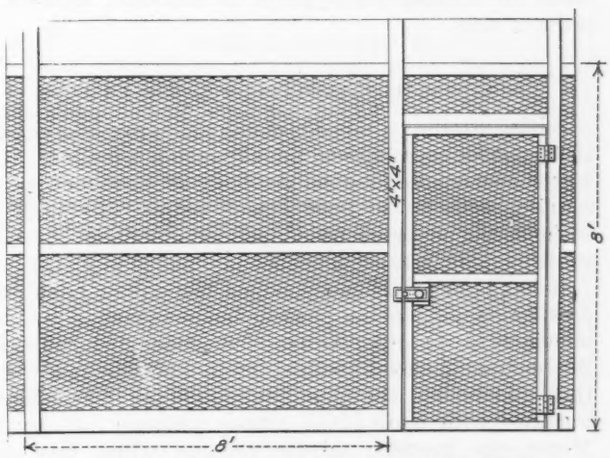
BY CLAUDE T. RICE

At the Gold Hunter plant at Mullan, Idaho, great trouble was experienced with the flotation froth in the Dorr thickener feeding the Oliver filter. The froth refused to "die," but would build up on top of the thickener and overflow, no matter how thick it became. Numerous expedients were tried without overcoming the difficulty in a satisfactory manner, until it was decided to scrape the froth off the top of the thickener. The apparatus was erected on top of another Dorr thickener that dewaters pulp for the flotation machines, so that a special arrangement of piping was necessary to carry the shaft down through the bottom without leakage. This was accomplished by bolting a flange to the bottom of the tank and then screwing into it a pipe that rises above the water level. The feed is delivered through a larger casting that extends down to carry the scraper arms discharging the pulp at the bottom of the tank. This casting is carried by spider arms at its top from the shaft itself.

In order to scrape the froth from the top of the tank as fast as it forms, two sweep arms were bolted to the top of the rotating casting. Two 4 in. by 3 ft. drags were attached to the end of these by means of eyebolts, which fasten into rods extending down from the arms. This allows the drags to swing and slide up the two skids that are placed to raise them over the top of the froth-discharge box. The top of the discharge box is an inch higher than the water level of the thickener. In order to drive the froth to the inside of the tank, a baffle board was extended to within three feet of the edge on the discharge side and then jogged three feet to join the discharge box itself. In this way an entrapment bay was formed where the froth accumulates and finally is pushed up over the lid of the discharge box. The refractory froth was much richer in lead than that which settled easily.

Expanded-Metal Partitions

Partitions are often found necessary in a milling, smelting, or hydrometallurgical plant to separate sections of the building for special purposes. In many instances it is found impracticable to arrange for exterior lighting or ventilation, and the use of expanded metal has been found suitable as a wall material.



DETAIL OF EXPANDED-METAL PARTITION

In precious-metal extraction plants provision must often be made against theft, and it is advisable to inclose sections of the building where there are amalgam plates, clean-up pans, mercury traps, or zinc precipitation boxes. In such conditions an arrangement which permits security, ease of inspection, ventilation and lighting will be appreciated.

The accompanying cut shows the details of an expanded metal partition and is taken from a pamphlet recently issued by the Expanded Metal Engineering Co., of 8 West 40th St., New York City.

Volatilization of Gold

The following conclusions have been drawn from a study of the subject of the volatilization of gold by Sir Thomas Kirke Rose, and are found at the conclusion of a paper on the subject which was presented at a meeting of the Institution of Mining and Metallurgy on Mar. 20, 1919:

1. True volatilization of gold is so small as to be

negligible at the temperatures of industrial melting furnaces, say 1000 to 1300°. It is difficult to measure with accuracy the infinitesimal amounts volatilized at these temperatures.

2. It is probable that the nature of the atmosphere, provided that it is maintained unchanged, has no effect on volatilization. Even in a strong draught, the amount volatilized remains exceedingly small.

3. Certain gold alloys when molten take up oxygen from atmospheres containing it, and will afterward spirt or effervesce in a reducing atmosphere until the oxygen has been removed. Similarly, hydrogen, and in a less degree carbon monoxide, are occluded by such molten alloys, and the metal then spirts in an oxidizing atmosphere. In spirting, showers of globules of the alloys of all sizes are thrown up, and the smaller ones, especially those of less than 0.001 mm. diameter, are carried away by any draught, however slight, and are difficult to recover. They can be collected by such a filter as cotton wool.

4. The action is observable in all the alloys of gold with silver or copper. Even parted gold containing 1 part per 1000 of silver is affected, though to a far less degree than coinage alloys, gold-silver parting alloys, and similar materials. Fine silver and its alloys with copper also spirt freely.

5. It is this action which causes the unrecovered losses in melting such alloys in crucibles without a cover of slag.

Flotation of Mixed Copper Ores

United States patent No. 1,288,121, granted Dec. 17, 1918, relates especially to the extraction of copper from mixed ores containing copper both as sulphide and as cuprite, with or without native copper and with or without the presence of copper in the form of other oxidized minerals, such as carbonates or silicates.

It has been proposed to recover the copper from such ores by subjecting the pulp to the action of dilute sulphuric acid, to dissolve oxidized copper, precipitating the copper, in metallic form, by a reducing agent, and then recovering the precipitated copper by flotation, together with undissolved copper sulphide. Harry W. Morse, the inventor of the process, which has been assigned to the Chino Copper Co., has discovered that when cuprite is present in the ore, a portion of the copper contained therein separates as metallic copper and may be recovered in the flotating operation, together with the precipitated copper and the copper sulphide.

The finely divided ore is treated with sulphuric acid in dilute water solution. This dissolves the carbonates, silicates, and similar soluble copper minerals. At the same time any cuprite which is present in the ore is decomposed according to the following reaction:

$$Cu_2O + H_2SO_4 = CuSO_4 + Cu + H_2O$$

One-half of the copper in the cuprite goes into solution as copper sulphate and one-half separates as metallic copper, remaining in the pulp. After treatment with the dilute sulphuric acid, the entire pulp is subjected to agitation in the presence of metallic iron, and copper is precipitated from solution as cement copper in the pulp. Fig. 1 is a flow sheet for the first method, hereinafter described, and Fig. 2 is a flow sheet for the second method.

First Method: Sulphides and metallic copper may be recovered by frothing flotation during the reaction with sulphuric acid of the oxidized minerals of the ore. To effect this, a flotation oil or flotation agents are added to the ore pulp, either before or after the addition of acid, or simultaneously with such addition, and the reaction with the oxidized minerals is produced in cells similar to those used in flotation operation, the cells serving as agitators to promote solution of material such as carbonates and silicates, and reaction with the cuprite as described above. These cells also permit simultaneous leaching with acid and flotation of sulphide minerals, together with any metallic copper which may have been present in the ore or produced from cuprite.

After leaving the first set of flotation cells, in which simultaneous leaching and flotation are being carried out, the entire pulp is passed through an agitating machine or precipitator, in which it is brought into contact with metallic iron in the form of shot or scrap or otherwise finely divided. In this step the copper in solution is precipitated as metallic (cement) copper. The entire pulp passing from the precipitator is then again subjected to flotation in a second flotation cell or set of cells in which cement copper which has been produced by the action of the iron, any remaining metallic copper from the ore or resulting from the decomposition of the cuprite by acid, as shown by the

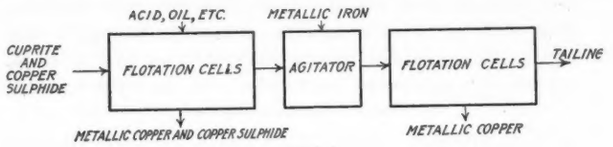


FIG. 1

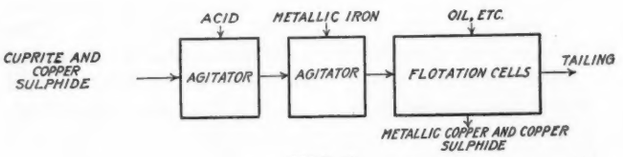


FIG. 2

FLOW SHEETS OF COPPER-ORE TREATMENT

above reaction, and any remaining sulphide minerals, are recovered by frothing flotation.

Second Method: Leaching as described may be carried out in any convenient agitating device, such as a mechanical or air agitator or in cells similar to those used in flotation operation, without, however, removing any mineral concentrate at this stage of the process. The pulp is then passed over scrap iron or shot iron in a machine adapted to agitate the mixture and precipitate copper from solution as finely divided (cement) copper. The entire pulp, containing sulphides and metallic copper, is then subjected to flotation, using, for example, any suitable flotation agent, such as oil, and any suitable flotation machine. The natural sulphides are recovered in this way, together with any metallic copper which may have been present in the ore and any metallic copper which has been produced by decomposition of the cuprite or precipitation from solution on metallic iron.

The advantage of this process in the case of ores containing cuprite lies in the economy of acid used for leaching and in the economy of iron used for precipitation. On a pure cuprite ore, only half the copper is dissolved as copper sulphate and precipitated by iron. The other half of the copper is produced in metallic form during the leaching operation and is recovered during flotation without additional expense for flotation agents, power for operating machinery, or labor for repairs or attendance.

Industrial News from Washington

By Paul Wooton, Special Correspondent

Department of Public Works Proposed

Without a dissenting vote the representatives of 74 engineering societies have endorsed the proposed establishment of a Department of Public Works in the Federal Government. It is the intention to include in this proposed department the two bureaus in which the mining industry is most interested—the Geological Survey and the Bureau of Mines. The conference at which this action was taken was held in Chicago on Apr. 23, 24, and 25, and was attended by the correspondent of the *Journal*.

The conference unanimously voted to attempt the grouping of all the engineering bureaus under one of the existing Cabinet officers, rather than to add a secretary to the President's Cabinet. Although no department was specified formally, it was the general understanding among the delegates that it is the Interior Department which is to be remodeled. The non-engineering bureaus already in that department will be detached. The Interior Department is composed, as it is, largely of engineering bureaus, employing more engineers than any other organization in the world. The idea is to group with them bureaus from other departments whose activities are chiefly of an engineering nature.

The meeting was called by the Engineering Council. J. Parke Channing, its chairman, in opening the conference, said in part:

> "Our Government has become the greatest industrial plant in all history—investigating, surveying, building, and operating. Its various functions are being conducted with practical independence, one with another, and with so little coördination and with so complete a lack of common purpose that practically the only occasions when the various elements become conscious of each other is when they overlap.
>
> "There are 12 Federal organizations engaged in making surveys. More than a score are conducting chemical investigations. In the *Congressional Directory*, 29 bureaus and agencies of Government engaged in construction of one or another kind are listed. Four Government departments are engaged in fuel tests."

Philip N. Moore, former president of the American Institute of Mining Engineers, in the course of his remarks at the conference, said:

> "For a generation, the dream of the civilian engineers of this country has been that one great department of our executive government, under the trained control of an experienced engineer, might have charge of all the non-military engineering tasks of the nation.
>
> "Owing to increased specializing, the engineer has multiplied societies and has not built up any organization with sufficient political potence to achieve in legislation the ideals of the profession.
>
> "Of the merits of some plan that shall coördinate, under one head, the vast engineering activities of the United States Government, which now function through a dozen or more bureaus, directed by six secretaries, there probably will be, in this meeting, few opponents. That opponents will be found elsewhere, fortified in power, we who favor the idea will soon realize.
>
> "Reconstruction is a common thought and word. Engineers have borne a great and honorable part in the war. Never before have their services been recognized so publicly and generally. Never before has there been so keen a realization of the complexity and lack of system in the engineering bureaus of the Government. Bureaus which in the past have competed with one another, and aimed at new activities and accompanying appropriations, now approve a more logical system."

As a result of the conference, active steps are to begin at once looking to the consummation of the proposals endorsed at the meeting.

War-Minerals Relief

On May 1, the war-minerals claims on the docket of the Relief Commission totaled over $4,000,000. Claims known to be pending on that date run the total of the relief asked to close to $6,000,000. The claims now on the docket are divided as follows:

Alabama—Pyrites, 1 claim, $200,000.

Arizona—Manganese, 5 claims, $45,000; and tungsten, 2 claims, $12,000.

Arkansas—Manganese, 20 claims, $350,000.

California—Chrome, 60 claims, $300,000; pyrites, 1 claim, $7000; manganese, 23 claims, $175,000; tungsten, 6 claims, $360,000.

Colorado—Manganese, 3 claims, $4000; tungsten, 5 claims, $15,000; and pyrites, 2 claims, $10,000.

Delaware—Chrome, 1 claim, $20,000.

Georgia—Manganese, 6 claims, $20,000; pyrites, 6 claims, $1,450,000.

Idaho—Manganese, 1 claim, $20,000; pyrites, 1 claim, $5000.

Maryland—Chrome, 1 claim, $55,000.

Minnesota—Manganese, 2 claims, $275,000.

Missouri—Pyrites, 1 claim, $5000.

Montana—Chrome, 2 claims, $20,000; manganese, 5 claims, $10,000.

Nevada—Manganese, 5 claims, $3000; tungsten, 5 claims, $95,000.

New Mexico—Manganese, 2 claims, $65,000.

New York—Pyrites, 1 claim, $500.

North Carolina—Manganese, 1 claim, $300.

Ohio—Pyrites, 1 claim, $200,000.

Oregon—Chrome, 30 claims, $40,000; manganese, 5 claims, $20,000.

Pennsylvania—Chrome, 1 claim, $30,000; manganese, 1 claim, $500.

Tennessee—Manganese, 6 claims, $30,000.

South Carolina—Manganese, 2 claims, $115,000.

Utah—Manganese, 5 claims, $20,000; pyrites, 1 claim, $2500; tungsten, 1 claim, $7000.

Virginia—Manganese, 2 claims, $40,000; pyrites, 1 claim, $3000.

Washington—Chrome, 2 claims, $20,000; manganese, 1 claim, $10,000.

The figures given are in round numbers. The engineers of the commission, under the direction of J. E. Spurr, are now engaged in examinations in connection with the Arkansas claims. The accounts of the claimants are being checked by a force of accountants under the direction of C. B. Holmes.

The second hearing in the claim of the Chestatee Pyrites and Chemical Co. has been postponed until May 16.

Sale of Picric-Acid Plant

Bids on the U. S. Government picric-acid plant at Brunswick, Ga., will be opened on May 20. The plant consists of a 2000-acre tract on which are all the necessary buildings for its operation, including a power plant and dwellings for officers and workmen, some partly completed. Bids for the plant must necessarily be for the entire Government property, including land, buildings, materials, and equipment. The bids will be opened on May 20 at the Cincinnati District Salvage Board.

The plant is at the present time open for inspection, and prospective bidders will be given all the facilities for inspecting the property for sale by applying to the Cincinnati Salvage Board at Cincinnati, Ohio.

New General Import License

The War Trade Board announces that a new general import license, to be known as General Import License PBF No. 37, has been issued covering the importation into the United States from all countries of the world except Germany (including the Rhine Provinces), Luxemburg, Hungary, and those parts of Russia under Bolshevik control, of all commodities with the exception of a number, including the following, the importation of which continues to be controlled by reason of existing agreements:

Pig tin, tin ore, tin concentrates and all metal alloys containing tin, including tin drosses, tin oxides, solder drosses, type metals, anti-friction metals, waste metals, and other miscellaneous metals containing tin.

Nitrate of soda and nitrate of potash.

Emery and emery ore, except that mined in Canada.

Withdrawal of "Black Lists"

Acting concurrently with the competent authorities of the associated governments, the War Trade Board announces that, on Apr. 29, 1919, all enemy trading lists heretofore issued or compiled by the War Trade Board will be withdrawn. On and after Apr. 29, 1919, all disabilities heretofore attached to trade and communication with persons included in such lists shall cease to operate, and all persons in the United States will be authorized, subject to the other rules and regulations of the War Trade Board and except as hereinafter provided, to trade and communicate with all persons outside of the United States with whom trade and communication is prohibited by the Trading With the Enemy Act.

This action does not modify or affect in any respect the present restrictions against trade and communication between the United States and Germany or Hungary, nor does it authorize trade with respect to any property which heretofore, pursuant to the provisions of the Trading With the Enemy Act as amended, has been reported to the Alien Property Custodian, or should have been so reported to him, or any property which heretofore, pursuant to the provisions of said act, the Alien Property Custodian has seized or has required to be conveyed, transferred, assigned, delivered, or paid over to him.

Engineering and Education

Encouraged by the nation-wide interest in the movement to incorporate in all engineering courses a greater amount of business training, the Bureau of Education has called a general conference on the subject to be held in Washington, June 23 and 24. It is expected that representatives of all technical schools in the country providing such courses will attend, as well as large numbers of other persons who are interested in the subject. The sessions will consider the questions of: (1) Business training for the engineer; (2) engineering training for commercial enterprises; (3) significance of the war experience for engineering education; (4) training of the engineer for overseas engineering projects.

Curricula suggestions will be submitted to the conference as follows:

First, That a minimum number of hours in business training, to be determined by the committee, be required in all engineering courses. In respect to this suggestion it was recommended, at the Washington Committee Conference, that from 12 to 18 semester hours be required in all engineering courses on the following subjects: General economics, cost accounting, business organization, and business law.

Second, That a curriculum providing for a minimum of 15 to 30 units in business economics be incorporated in all engineering courses and offered on an elective basis. In respect to this suggestion the Washington Committee Conference recommended that electives be encouraged in connection with all engineering courses in the following subjects: Labor and employment problems, statistics, corporation management and finance, political science, marketing, including advertising and salesmanship; psychology, scientific management, and transportation. It was further recommended that economic phases of engineering subjects be emphasized wherever possible in engineering instruction.

Third, That a curriculum in commercial or industrial engineering, permitting full and proper emphasis upon engineering subjects, be offered in the School of Commerce, with degree to be given in that school.

Fourth, That a five-year combined engineering and commercial course be prepared.

It was recommended at the Washington Committee Conference that no action be taken at this time on the latter two suggestions.

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The Mining and Metallurgical Society Of America

At the meeting of the New York Section of the Mining and Metallurgical Society of America held on Apr. 30, three interesting papers were presented. Dr. Thomas Darlington spoke upon the subject of fatigue, and, after indicating the physiological cause for fatigue, showed the practical side of the subject in relation to industry. Cleanliness, well-selected food, proper living conditions, and knowledge of how to live are the important factors that enable a worker to accomplish his stint easily and cheerfully. Efficiency of the worker is just as much a matter of proper health as of good superintendence. Tactful direction and suggestion having for their object the betterment of the worker's living conditions are as necessary in the successful handling of labor as is intelligent supervision.

J. M. Larkin, of the Bethlehem Steel Co., discussed the plans of his company for the prevention of labor disputes and for the securing of a better understanding between the workers and the managerial force. The system used is similar to the Rockefeller plan first initiated by the Colorado Fuel and Iron Co. Under the system representatives elected by the workers confer with the shop managers on all questions which arise between the company and the workmen.

P. G. Beckett, of the Phelps Dodge Corporation, was the next speaker, and briefly described the system instituted by his company at its Arizona properties. A. H. Rogers, H. H. Knox, W. R. Ingalls, and Dr. Darlington took part in the discussion. The meeting was presided over by Benjamin F. Tillson, in the absence of George C. Stone.

Chronology of Mining for April

Apr. 1—Agreement between Government and copper producers became effective, calling for purchase by producers of 5,000,000 lb. copper per month for 10 months and 10,000,000 lb. per month for the next five months. Report received of strike of smelter men in some zinc plants in Oklahoma, owing to wage reduction.

Apr. 2—Meeting of representatives of potash companies to form the National Potash Association, in Denver.

Apr. 3—Committee of zinc producers met Director of Sales in the War Department to consider liquidation of stock of spelter held by the Government.

Apr. 4—Announcement made of reduction of $1 a day in wages of metal miners, effective May 1, by Iron Silver Mining Co., operating in Leadville district, and at Yak mines of American Smelting and Refining Co., affecting about 1000 men.

Apr. 6—First meeting of board consisting of the Governor of Idaho, the Inspector of Mines, and others interested, to effect organization of new State Bureau of Mines and Geology.

Apr. 7—Sales of German-owned stock of Compañia de Minerales y Metales, S. A., and American Metal Co. by Alien Property Custodian.

Apr. 12—War Department issued statement regarding disposal of its surplus stocks of lead.—Opening of navigation for iron-ore shipments on the Lakes, being the earliest date in 41 years.

Apr. 15—Initial hearing before War-Minerals Relief Commission.

Apr. 18—U. S. Shipping Board approved rates of shipment for ore, grain, and coal on the Great Lakes for the coming season.

Apr. 19—Announcement of important strike in C. and C. shaft of Consolidated Virginia on the Comstock Lode.

Apr. 20—Miners at many large properties in Leadville district walked out, some of the operators previously having pulled the pumps.

Apr. 21—Fire destroyed buildings at Sunnyside mine, at Eureka, Colo., causing damage of $225,000.—Reports received of filing of complaint by 11 large mining companies against high freight rates put into effect by the Railroad Administration.

Apr. 22—Miners' committee and Leadville operators agree on a minimum wage of $4 per day.

Apr. 23—Anaconda Copper Mining Co. reported to be operating 11 properties out of 31 either owned or controlled by the company, production being about 55% of normal.

Apr. 24—Cave-in occurred at Granby Mine, at Phoenix, B. C.

Apr. 29—Explosion in Majestic Coal Mining Co.'s mine, 22 miles from Birmingham, Ala., killed 17 miners, injuring seven others.

Licensing of Engineers

DENVER CORRESPONDENCE

Licensing of engineers in the State of Colorado has been provided for by the passage of Senate Bill No. 339, which creates a State Board of Engineer Examiners. The passage of this bill was a complete surprise to fully 90% of the engineers of the state. The supporters of the measure claim that they made every effort to advise the engineering profession of the state, and gain their support. On the other hand, many engineers never heard of the bill until notice of its passage appeared in the newspapers, and some express the belief that the supporters of the measure deliberately refrained from publicity so as to avoid adverse influence.

Conservative engineers are generally of the opinion that such a law can serve no good purpose and is likely to be harmful to developments in the state. It is pointed out that many engineers from other states come to Colorado temporarily to render professional service, and that such a law as the one recently enacted will cause such visiting engineers exasperating inconvenience and delay on account of the usual red tape in connection with such a measure. This is particularly true in the case of mining and metallurgical engineers. It appears that every engineer who desires to carry on professional practice in the state must secure a license within 90 days from the passage of the law.

To secure this license he must apply for either an engineer's or a surveyor's license, appear before an examining board, and pass an examination. A surveyor's examination is a simple matter, but how such a board can properly examine a great variety of specialists to determine whether they are competent to serve their clients' interests is not explained in the bill.

The examining board is to consist of five members, including the State Engineer, who becomes a member ex officio. The four members to be appointed by the Governor are to serve without pay. Presumably, these members of the examining board should represent as many engineering professions as possible, and be com-

petent, broad-minded men, with considerable judgment and discretion.

However, it is a well-known practice in making political appointments to make the selections so that the appointees will be geographically distributed, without regard to technical qualifications. Various engineering and technical societies representing different engineering professions in Colorado have held meetings for the purpose of selecting men who would be desirable as members of the Board of Engineer Examiners as provided in the law. These proposals will be placed before the Governor with a view to assisting him in making a choice of suitable examiners, in case he desires to avail himself of such suggestions.

Engineers in Colorado whose abilities are beyond question are inclined to regard the bill as an example of freak legislation that is more likely to be a nuisance than a benefit. Others are disposed to view the matter with some alarm, as suggestive of some subtle movement toward unionism of professional men. The supporters of the bill claim that its object is to eliminate impostors.

French Imports of Metals and Ores

The following figures of imports of metals and ores during the last three years are given in *L'Echo des Mines et de la Metallurgie* of Mar. 23, 1919:

	1916 Metric Tons	1917 Metric Tons	1918 Metric Tons
Metals:			
Crude copper	153,091	188,886	152,645
Copper bars	6,554	28,992	7,541
Copper sheets	13,364	31,260	6,595
Lead, argentiferous	9,195	3,676	7,382
Lead, ordinary	54,544	54,170	44,059
Tin	10,226	12,641	10,127
Spelter	63,206	72,909	45,587
Nickel	1,760	1,871	823
Aluminum	739	1,350	7,219
Mercury	568	490	852
Ores:			
Copper	1,591	4,030	427
Lead	40,750	36,027	24,128
Tin	445	333	50
Zinc	56,727	36,430	61,356
Nickel	8,915	5,152	3,289
Antimony	10,697	13,665	2,015
Manganese	58,658	77,356	59,296
Pyrites	79,234	49,162	32,101

During the last two years the copper imported into France came principally from the United States, only about 20,000 tons being received from England, Japan and other countries.

Of the pig lead, Spain supplied 53,000, 41,000, and 37,000 tons in 1916, 1917, and 1918, respectively.

Practically all of the tin came from England and the Dutch East Indies. The big increase in aluminum imports in 1918, which metal came mainly from Norway and the United States, was due in the main to aviation requirements.

Walter Douglas on the Copper Situation

ARIZONA CORRESPONDENCE

After a short visit to California, Walter Douglas, president of the Phelps Dodge Corporation, has been making a close inspection of the company's properties in the Southwest, including the Moctezuma, near Nacozari, Sonora. He has been quoted as expressing belief that a brisk demand for copper will spring up by the end of the year. In the meantime, the strictest economy must be maintained around the mines, as some companies are losing money on every pound of copper produced, having to borrow to meet their current expenses. Mr. Douglas made reference to the reserves of his own company as comprising large sums in Liberty bonds, which should not be disposed of now, and which ultimately will be worth more than was paid for them. He said that the main object of the company now is "to make the depression as little felt as possible in the camps which are dependent wholly upon company operation for their living, and also to provide work for our old employees who are coming home from the war."

The return of many employees who went to the war has created a serious employment problem of late for the Copper Queen and Calumet & Arizona companies, in consideration of their desire to cut work and production down to the lowest logical limit. Employees have been placed in five classes, to which assignments are made with the assistance of an elected employees' welfare committee of nine. First considered are old employees, with dependents. Soldiers, sailors and marines are next. Class 3 generally embraces men without dependents who have been over two years with either of the companies, as well as older employees who are not citizens. Class 4 mainly covers men of 18-months' employment, with dependents, and the last class the newer employees without dependents.

Warns of Oil-Stock Fakes

Assistant District Attorney Theodore L. Waugh, of New York County, who has been investigating sales of oil stock on the curb, has issued a warning against buying stock from curb brokers not members of the Curb Market Association and further advised that no stock should be bought unless it was on the approved curb list. Anyone buying stock should compel the broker who sells the same to sign his name to the circular setting forth his claims to the stock, by which means the District Attorney's office will have a basis for criminal action if the stock proves to be that of a fake concern. The District Attorney is being assisted by Fred B. Sturges, secretary of the Curb Market Association.

Vocational Education and the Disabled Soldier

There are 14 district offices of the Federal Board for Vocational Education, established in as many different cities of the country, to facilitate contact with disabled soldiers, sailors, and marines; and to date the average number of cases handled by each office is 1972. Of the large number of applications made to the Federal Board for training, only 65 have been definitely disapproved, whereas 3841 have been recommended for training by the district boards, and of this number 2704 have been approved by the Federal Board.

These district offices are organized to facilitate getting in touch with disabled men; and it is not even necessary for a disabled man to call in person at the branch office. If he is at a distance and will notify the office of his district that he is disabled and prevented, either by lack of funds or otherwise, from coming in person, the board will send a vocational adviser to see him and make the preliminary investigation at his home, and, if it is necessary for him to appear before the local "Case Board," his expenses are of course defrayed.

Following are the branch offices of the Federal Board: Room 433 Tremont Bldg., Boston, Mass.; Room 711, 280 Broadway, New York; 1000 Penn Square Bldg., Philadelphia, Penn.; 606 F St., N. W., Washington, D. C.; 823 Forsyth Bldg., Atlanta, Ga.; 822 Maison Blanche Annex, New Orleans, La.; 1212-14 Mercantile Library Bldg., St. Louis, Mo.; Room 742 Metropolitan Bank Bldg., Minneapolis, Minn.; 909 Seventeenth St., Denver, Colo.; 997 Monadnock Bldg., San Francisco, Calif; Room 539 Central Bldg., Seattle, Wash.; and 810 Western Indemnity Bldg., Dallas, Texas.

The International Labor Commission And the Peace Treaty*

The nine clauses proposed by the commission on international labor legislation for insertion in the peace treaty as adopted by the Peace Conference in plenary session at Paris were made public at Washington on Apr. 29 by the State Department.

Among the principles incorporated are a standard eight-hour day, a weekly day of rest, the abolition of child labor, equality of pay for men and women, and workmen's "right of association for all lawful purposes."

The text of the clauses, as adopted, follows:

"The high contracting parties, recognizing that the well-being, physical, moral and intellectual, of industrial wage earners is of supreme international importance, have framed a permanent machinery associated with that of the League of Nations to further this great end. They recognize that difference of climate, habits and customs, of economic opportunity and industrial tradition make strict uniformity in the conditions of labor difficult of immediate attainment. But, holding as they do, that labor 'remedies' (probably error in transmission) be regarded merely as an article of commerce, they think that there are methods and principles for the 'ratification' (probably error in transmission) of labor conditions, which all industrial communities should endeavor to apply so far as their special circumstances will permit.

"Among these methods and principles, the following seem to the high contracting parties to be of special and urgent importance:

"First—The guiding principle above enunciated that labor should not be regarded merely as a commodity or article of commerce.

"Second—The right of association for all lawful purposes by the employed as well as by the employers.

"Third—The payment to the employed of a wage adequate to maintain a reasonable standard of life as this is understood in their time and country.

"Fourth—The adoption of an eight-hour day or a 48-hour week as the standard to be aimed at where it has not already been obtained.

"Fifth—The adoption of a weekly rest of at least 24 hours, which should include Sunday whenever practicable.

"Sixth—The abolition of child labor and the imposition of such limitations on the labor of young persons as shall permit the continuation of their education and assure their proper physical development.

"Seventh—The principle that men and women should receive equal remuneration for work of equal value.

"Eighth—The standard set by law in each country with respect to the condition of labor should have due regard to the equitable economic treatment of all workers lawfully resident therein.

"Ninth—Each state should make provision for a system of inspection, in which women should take part, in order to insure the enforcement of the laws and regulations for the protection of the employed.

"Without claiming that these methods and principles are either complete or final, the high contracting parties are of opinion that they are well fitted to guide the policy of the League of Nations, and that if adopted by the industrial communities which are members of the league, and safeguarded in practice by an adequate system of such inspection, they will confer lasting benefits upon the wage earners of the world."

*From the New York *Tribune*, Apr. 30, 1919.

Mining in Australia

MELBOURNE CORRESPONDENCE

Wallaroo & Moonta Mining and Smelting Co., Ltd., had an output for the year 1918 which amounted to 9290 tons refined copper, including 1454 tons electrolytic and 2266 tons of Mount Cuthbert Co. blister. The cost per ton of copper, f.o.b. ocean steamer, was £92 15s. 11d. Speaking at the annual meeting of shareholders in Adelaide on Mar. 26, the chairman of directors, Sir Lancelot Stirling, after referring to the slump in the price of copper, said the position of the company was a difficult one. If shipping were available to enable the company to realize on its product it would receive, if the market remained steady, about £70 per ton f.o.b. at Sydney, though the cost of production to the same point was about £90 per ton.

It was evident that no matter how important the company, as a big employer of labor, regarded its obligations to the nation to retain the men in full work, it could not for long carry such a financial burden. The position was further complicated by the fact that the lack of shipping prevented the company from realizing on its product, and it therefore became a question of finding the money with which to pay the men. The British government again coming to the assistance of the industry by providing some means whereby copper can be shipped, and the costs and the market price brought closer together, would alone prevent the cessation of operations. Continuing, the chairman said that if anything did mature it could not mean profit to the company, but by preventing heavy losses it would enable it, at any rate, to keep part of the men at work. Shareholders should also realize the fact that apart from the liability still to be met under the war-time profits tax, the cost of keeping the mines in order for future work would not be less than £72,000 per year. The attitude of a section of the company's employees had been disappointing. The company had treated the men with full consideration in regard to their earnings, and they had participated largely in the result of the high copper market. The directors were disappointed now that some were not satisfied to accept the lower rates in the sliding scale when the value of copper dropped. The company was now concerned in an appeal by some of the men to the arbitration court, and it was possible that the long-established system of wages and bonus allowance might have to be abolished.

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Editorials

Prosperity—Let's Go

IN A MEMORABLE speech made recently at St. Louis before the Seventh Annual Convention of the United States Chamber of Commerce, Secretary Glass of the Treasury Department stated:

"The American people should supplement the patriotism of war by the patriotism of peace, and just as the American soldiers on the field battled to notable conquest for liberty, so American business men, in different ways and through different instrumentalities, should now give expression to their patriotism by promptly and cheerfully meeting the obligations of citizenship. The foremost obligation of which I can think is the duty of every American citizen, whether of humble or high station, to guard jealously the honor of the nation; to regard its commitments as his own, and willingly contribute his labor and his substance for complete payment of our debt in the spirit of the National Prosperity Campaign, whose efforts for the stimulation of business and confidence have been spread broadcast throughout the country over the slogan of LET'S GO.

"We should start right away; we should break in upon this unnatural, abnormal suspension of commercial activities; for there is a world to be rebuilt, and why should we stand timidly by and question as to our opportunity?

"The spirit of confidence which made all the previous Liberty Loans successful assures the success of this present Victory Loan; that spirit which has brought our nation through the recent struggle has at the same time made the United States supreme in a financial sense.

"Has not a record of that sort any lesson for us? Should it not give us heart and spirit to go forward upon a field of prosperity such as never passed before the vision of any business community on this earth in all of its history?

"I say, should not this record banish fear and stir the spirit of business adventure and carry us confidently and swiftly along toward the goal of national supremacy in the wider field of commercial activity?

"LET'S GO."

Maintenance and Repair

THE mining companies are doing their full share to minimize the seriousness of the problem of unemployment by keeping their men employed to as great extent as is possible. In spite of a pronounced curtailment of production, many men are being kept at work, development operations are being pushed, and ore reserves being built up. Keeping men at work and extending development are sound policies. Making repairs to surface and underground plants and keeping mechanical equipment in good condition are other timely and effective means of reinstituting conditions that will in the near future be of marked advantage to the mining industry. Before the war, maintenance and repair were essential parts of the operating program, and good management dictated the upkeep of all mechanical appurtenances. During the rush for production caused by war needs, both maintenance and repair were relegated to the background, to await a time when mechanics and repair men would be available.

Now is the time to catch up. Every piece of machinery should be overhauled and put into the best mechanical condition. Section by section, ore-dressing plants should be completely overhauled. At the smelteries, furnaces should be overhauled and worn-out equipment replaced. There is much that can be done to restore plant equipment to pre-war efficiency.

Col. Arthur Woods, special assistant to the Secretary of War in the work of obtaining positions for discharged service men, predicts a labor shortage before the end of this year. If this be, indeed, the prospective conditions, there is all the more reason for taking advantage of the present opportunity. The same policy of the resumption of maintenance and repair work in all lines of industry, as well as in mining, will go far toward enlivening the demand for materials, machinery, and supplies. The renewal of industrial activity on a one-hundred per cent. basis is confidently to be looked for in the near future. Being ready for that resumption will bring a decided advantage to those who are far-sighted enough to prepare for it now.

Mexico

DURING the month of April the news from Mexico, though more or less conflicting, gave the impression that the government was making some progress in restoring order in at least some parts of that country.

If it is correct, as reported from Mexico City on Apr. 11, that Emiliano Zapata has been killed, there has been removed from the side of the Mexican government a thorn that for years has been the cause of constant irritation. Zapata was a man possessing the gift of leadership, and, an Indian himself, may have been entirely sincere in his early efforts to return the large estates of the south to the Indians. This, however, resulted only in laying waste a large area of prosperous country and placing those whom he pretended to help in a worse plight than they had ever been before. The old town of Cuernavaca, the delight of those who have a love for Mexico and things Mexican, is said to be in ruins. Nowhere in all the south could be found such a church; richly colored with the paint of time and its walls covered with a wild profusion of lavender-tinted creepers. Its paintings are destroyed, as are also the historic and picturesque gardens which drew many travelers to this quaint old town.

Throughout the country peace and order have been replaced by a feeling of unrest. This is contagious, and, without knowing just why, the traveler feels it too. In the old days he would invariably lean back in the seat of his Pullman and go to sleep between stations, merely waking up when the train stopped to watch the whole of Don Pancho's family who had come down from the ranch in coach and on muleback, with their hundred and one

packages and contingent of family servants. Today the traveler is awake and experiences a feeling of relief every time a bridge is passed, or a railway cut, still marked with the remains of a train that was wrecked or burned, is left behind. No family parties are going to the city, and the laughing, happy, noisy throng that filled and overran the second-class coaches is replaced by a few warm and tired and hungry-looking peones, who, there is reason to fear, may not be on entirely peaceful missions.

One may hear of no disorder or he may hear only a rumor of disorders in some remote district, but a different atmosphere prevails, and old Mexico has not come back, even where perfect order prevails. The traveler on muleback reaches the old stopping-place at sundown, but it is not familiar. The old church which he recalls as a sentinel, waking only once a year when the padre came around to baptize the last crop of children and celebrate the year's marriages, is still there, but somehow it looks like a ghost. The feeling that it will never wake again persists. The sun goes down, and the traveler turns in, not with the sole thought of getting a good night's rest, but wondering, as they say in Spanish, "if he will wake up dead."

It is, indeed, a most encouraging prospect if the main cause of disorder in Morelos has been removed. Would we could say the same of Chihuahua, where Villa and his lieutenants still continue to take under their protection foreign citizens, whom they look after carefully until substantial bills for board and lodging have been rendered and paid. This is such a profitable business that it may have been a reason for the formation in Texas of a band of Villa recruits, who, however, got no further than the border and are now in a position where about twenty of them may have to pay Uncle Sam a considerable bill before they are permitted to pass from his care.

Possibly there are no greater number of hold-ups daily in Mexico than in New York City, but the fact that foreigners are so frequently the objects of violence creates the impression of general disorder. One of the latest atrocities noted was the murder of Edward L. Dufourcq, a well-known and highly esteemed mining engineer of New York. Though the details of this outrage have not reached us, and although the murder cannot be attributed to the Carranza government, that government is directly responsible for the fact that Dufourcq's murderers were allowed to operate and escape and to continue as a menace in the State of Pueblo.

Can it be that the present Mexican government does not appreciate the harm that is done to the whole country by permitting such a state of affairs, or is the government simply incapable of putting a stop to the constantly recurring atrocities? We imagine that the experience of the Minister of Finance on his recent visit to this country in search of financial support may have thrown some light on the situation, as did also the reported refusal of the peace delegates to receive a diplomatic representative from Mexico. Both instances must have been forceful reminders to that country that considerable housecleaning must be done before extended outside assistance can be regarded as feasible. If it is true that Limantour has been asked to return to Mexico City, this may be taken as tangible evidence that the Carranza government realizes its difficulties and is going to a logical and proper source for advice and assistance.

Along the Texas-Mexico border visitors from the south have recently been less fortunate in their raids, and United States troops that have crossed in pursuit have been fairly successful in their objectives, so successful that a number of Villa adherents and former Carranza soldiers have crossed the Rio Grande for the last time. That a better feeling on either side of the Rio Grande now exists is evidenced by the recent meeting of Mexican and Texas governors at Nuevo Laredo on Apr. 7 for the purpose of exchanging expressions of good will. This may mean no practical improvement in the interior of the country, but it helps a little toward a better understanding.

The American Smelting and Refining Co. and the United States Smelting, Refining and Mining Co. both report increasing business. The report of the Mexican national receipts for 1918, now available, shows a respectable total from duties and taxes, with a prospect of a further increase from these sources during the present year. It is pointed out that this increase of receipts may foreshadow some returns to those who hold the bonds of the Mexican railways, but this appears extremely doubtful, in view of the vast amount of repair work required upon the roads and the expense of keeping them open if they are to be operated at all.

The Mexican Congress has just convened, and it is the sincere hope of Americans who have interests in Mexico that energetic steps will be taken to restore order in the troublesome mining districts and insure equitable treatment of foreign mining and business interests. When the Congress of the United States meets, various phases of the peace program will press for solution, and, though most attention will be focused on affairs across the Atlantic, there will still be the Mexican problem, which cannot much longer be denied the attention that it demands.

Foreign Trade and the Mining Industry

THE stimulation of foreign trade is of more than passing interest to the mining industry. It is evident that any increase in the market for manufactured articles, particularly those in which metal is an essential constituent, such as hardware, mining and agricultural machinery, electrical and power equipment, will materially increase the demand for the basic metals. A comprehensive business policy and legislative program for the development of the foreign trade of the United States is greatly to be desired, and would have the strong support of all mining interests. Active steps are now being taken by the National Foreign Trade Council toward establishing such a policy and program. At its convention recently held in Chicago the significant recommendations which are summarized herewith were presented:

The earliest possible completion of the Government's present shipbuilding program.

The Government should immediately remove all restrictions now placed on American shipbuilding and permit the free construction of vessels for sale to foreign interests.

There is imperative need of a revision of our shipping, navigation, classification, and measurement laws so that American vessels may be placed on a more equitable basis of competitive operative costs in foreign trade.

Opposition to any continuance of Government operation of the United States merchant marine.

It is urged that the Government-owned vessels be allocated to suitable trades and trading routes for operation by any qualified competent American shipping enterprise, under conditions of sale or charter that will permit of their sending the American flag to any port of the world on a fair trading competitive basis.

Establishment of necessary coal and fuel-oil depots on all the great foreign trading routes, so that American shipping shall not be dependent upon foreign-owned facilities for such vital service.

Adequate telegraphic facilities with all foreign countries for the benefit of American exporters.

Establishment of free zones at the principal American ports where products from all countries may be assembled, classified, manufactured and reshipped.

Enactment of laws providing a bargaining tariff for the protection of American commercial interests in foreign countries.

Extension of the international parcel-post service.

The program merits the prompt attention of Congress at its next session. The domestic trade of the United States is enormous, but it requires the addition of a relatively large foreign trade to insure the consumption of our basic products at remunerative prices. That our foreign trade will increase rapidly goes without saying, but we are not so sanguine that it will take care of itself. We may well say that nothing takes care of itself particularly well. The nation has been engrossed with domestic affairs hitherto, but the war has broadened our interests, and it is greatly to be desired that we give to the development of foreign trade the attention which it deserves.

Copper Slags

THE slags formed in the smelting of copper ores and in the converting of copper mattes have always been of interest to the copper metallurgist. To the pioneer metallurgist, as well as to his successor, the chemical composition of the slag first commanded attention. Undoubtedly some of the first slags that would run properly, and not crust up the hearth of the blast furnace, were obtained by cut-and-try methods. Effective smelting mixtures were obtained by the increase or decrease of the proportions of the ore and the limestone flux. Practical smelters were men who were gifted with a considerable degree of native shrewdness, and who were quick to detect variations in the physical character of the slags as they issued from the blast furnace. By prompt adjustment of the charges, trouble was avoided in time, and the work proceeded without serious delay.

As smelting operations increased in magnitude, more and more use was made of the chemist, until it became the ruling practice to analyze the constituents of the charge and the fluxes, and to make calculations of the furnace charge that would give slags of certain compositions. More and more information was obtained of the characteristics of certain slags, and further information obtained of the effect of specific ore constituents. Finally the accumulated information was sufficient to make the smelting practice an approximately exact process. The practical smelter was then replaced by the trained metallurgist.

Scientific investigation kept pace with the increase in the size of smelting operations. The classic experiments of Hoffman and of Fulton gave information about formation temperatures and the relation between chemical composition and physical characteristics. The development of slags that were metallurgically efficient—that is, that would run freely, that would form at temperatures within certain limits and that would permit of economical ore mixtures—followed simultaneously with the scientific investigations. In the smelting plants the metallurgists made progress in obtaining slags of lower and lower copper content. The demand made upon them was to reduce the metal losses in smelting to the lowest possible figures. In blast-furnace smelting, larger and larger forehearths were demanded, until a practical limit to the settling out of matte in suspension was reached. In reverberatory smelting, larger and still larger reverberatories were used, with the objectives of securing cleaner slags and higher fuel efficiencies. Probably the limit of effective settling in both blast and reverberatory smelting has been reached.

The modern metallurgist refuses to be satisfied; and no sooner does there appear a culminating point in practice than new methods of investigation are seized upon, and the prevailing practice is subjected to critical examination. An investigation of this kind is presented in the current issue. Progress results from the thorough study of specific problems, and it is for this reason that the article of C. G. Maier and G. D. Van Arsdale will be welcomed by copper metallurgists. By an ingenious combination of chemical and physical methods of investigation, these two research chemists have determined for certain slags that oxidized copper compounds are not present, and that there is almost a fixed amount of dissolved copper in all of the blast-furnace and reverberatory-furnace slags examined. This copper is not in the form of matte, as might readily be supposed, but in that of sulphide copper. The practicable point is the demonstration of the limit to which settling practice can go in reducing the copper content of slags. Another important conclusion is that copper in excess of the dissolved copper is retained in suspension by flotative action, caused by the liberation of gas formed by the action of ferric oxide. As the investigators suggest, this indicates the desirability of reducing or eliminating the amount of ferric iron in the slag.

Although the amount of copper that could be saved by preventing this flotative action ranges from two to four pounds per ton of slag, under adequate settling conditions, and would perhaps, in some cases, be considered negligible, in other circumstances it might represent an important saving that could be effected by slight variations in the preliminary treatment of the charge, and without great increase in cost.

Available Shipping

THE matter of available shipping for raw and manufactured articles of American production is today of more than passing interest to the producer and to the manufacturer. Even though a foreign demand exists, it will be useless, while few ships are available for export business, to produce beyond the capacity of the American market to absorb.

There is some satisfaction in the information given out by John H. Rosseter, director of operations, U. S. Shipping Board, that within the next 30 days ample tonnage will be available for export trade.

If it is a fact that certain industries are being held back through inability to ship, there is in this news warrant for hope of material relief; but for the American people as a whole the more significant statement by Mr. Rosseter is that "The shipping board has provided not less than 1,390,000 dead-weight tons of steamers for European relief during the period of three months."

The trade that America needs particularly to have restored is that with European nations. This is the trade that affects every branch of our own industrial life, and the restoration of this trade depends upon such restoration of European conditions as will again permit of an exchange of goods. The first step in this restoration is admittedly that of bringing normal health to the populations of the devastated countries through supplying them with food, and the second step is to provide them with raw materials.

Individual sacrifices have been made and contracts have been lost through inability to secure carriers from the United States, and there will undoubtedly be other similar cases, despite the promise that has been made. In making these sacrifices, however, we can take comfort in the thought that the Shipping Board, in sending every ton of food possible to Europe and bringing our men home with the greatest possible dispatch, is acting in the best interest of the American people as a whole.

BY THE WAY

It is interesting to note in Henry M. Stanley's account of his famous expedition in 1871-1872 to rescue David Livingstone, the African explorer, reference to the now well-known Katanga copper mine. He says: "Rua, at a place called Katanga, is rich in copper. The mines of this place have been worked for ages. In the bed of the stream gold has been found, washed down in pencil-shaped pieces or in particles as large as a split pea. Two Arabs have gone thither to prospect for the metal, but as they are ignorant of the art of gold mining it is scarcely possible they will succeed."

In a recent issue of *The Youth's Companion* a writer gives an account of the vicissitudes of the life of a prospector. Wishing to register a claim location without delay, he set out by a direct route over the mountain. Miscalculating the time it would take to urge his patient burro over the range, darkness came before he had reached the regular trail, and knowing that the safest way was to trust to the animal's instinct, he plodded long behind, with a firm grasp on Jack's tail. Suddenly the burro swerved to one side and stopped, leaving his master standing on nothing. In a few moments came the realization that a prospective millionaire was suspended in an old mine shaft, with nothing but the tail to save him from a plunge to unknown depths, the chances of rescue in that unfrequented spot being slight. No command, request, entreaty, or curse would make that burro budge; and each struggle to climb caused the animal to kick. Finally a kick in the jaw almost ended matters, but a frantic wave of the arm to ward off the next kick brought the hand in contact with a bush. After testing the strength of this new support, a careful transfer was made. But, horrors! While the spirit was more than willing to climb out of the pit, the body was weakened by the long strain. Drops of cold perspiration began to collect and trickle down, conjuring up awlful visions of a mangled corpse lying below with the mine seepage dripping upon it. After what seemed hours of agony, there came the will to end it all by letting go and dropping to oblivion. But the hands, now cramped, refused to open. Then came the phantasm of a dried and shriveled mummy, swayed by the wind at the edge of the pit's mouth. Finally, as with a maniacal shriek one last effort was made to regain the surface, the bush gave way, and down plunged the victim, seeming to float on air for a space and then landing in a confused heap at the bottom of the excavation. Unconsciousness came so quickly that there was no torture of pain such as would naturally be inferred where there seemed every chance of being mashed to a pulp. After a time a ray of moonlight and a return of the senses brought an appreciation of the fact that the supposed abandoned mine was merely an "assessment hole" and that the fall measured exactly six inches. In a few moments the burro was compelled to desist from his meal of bunch grass and resume his function as a saddle animal.

"Did'st thee make h'out one o' these 'ere tax h'income returns?" said Cap'n Dick. "Dam-me, m'son, I call un some bloody beauty you, an' a man mus' be pretty near a scholar to get 'en right. One thing certain, for sure, 'e mus' be smarter than Jan Broad. Jan, 'e'd gone to night school, an', min' you, 'e did'nt 'esitate baout tellin' people. One day Jimmy Kevern asked 'im, ' 'Ere naow, Jan, thee be so bloody smart with this 'ere night school, 'ow much is 'leven poun' o' 'errin' at 'leven cents a poun'?' 'Simple nuff', sez Jan, 'Give us a bit o' pencil an' scrap o' paper an' I'll fixun.' So Jimmy, 'e gives un a pencil an paper, an' Jan 'e sits daown to work un h'out. Firs' 'e covers one side o' tha paper with figgers an' then 'e turns un h'over an' writes daown h'other side. 'Dam-me,' sez e, 'can't seem to figger'n h'out no'ow. W'ot was tha bloody problem, any'ow?' 'Simple nuff,' sez Jimmy, ' 'Ow much is 'leven poun' o' 'errin at 'leven cents a poun'?' 'Oh, dam-me,' sez Jan, 'No wonner could'nt figger'n h'out. 'Ere wuz I figger'n mackerel h'all tha time!' "

D. E. A. C.

An amusing anecdote is going the rounds in connection with the search for petroleum in Derbyshire, England. It is reported that Lord Cowdray is beginning to bore in various places what are known to the drilling profession as wildcat wells. His agent found promising indications in one locality (presumably Foxstones), and forwarded a bottle containing a sample of the first crude petroleum from the prospect. Being in somewhat of a hurry, Lord Cowdray handed the bottle to one of his servants. The man started out with the bottle and a note, but stopped to visit his family on the way. He suddenly remembered his errand; and, picking up from a shelf what he thought was the same bottle, hurried out to deliver it. In the morning Cowdray received from the chemist a telegram to the effect that congratulations were in order in view of the greatest find of the century, adding "You have struck paregoric."

By the Way—Have you bought your Victory Note?

Personals

Tom L. Gibson is making mine examinations in the Kingman, Ariz., district.

Frederick Burbidge recently made an inspection trip of properties in Oklahoma.

Albert Burch recently examined gold properties in El Dorado County, California.

E. O. Daue has just returned to Philadelphia from a professional trip to Georgia.

A. J. Robin has accepted a position with the Mazapil Copper Co. at Saltillo, Coahuila.

Charles A. Burdick has changed his address to 1834 Equitable Bldg., New York City.

S. H. Ball left for the Southwest on Apr. 10. He expects to be absent for about one month.

J. K. MacGowan has been elected a director of the Chile Copper Co. in place of F. R. Foraker.

Stanly A. Easton was elected a delegate-at-large at the annual convention of the Idaho Mining Association.

Edwin J. Collins, mining engineer of Duluth, has returned from a 10-weeks' trip through the west and southwest.

N. L. Wimmler is returning to the Orient, and his temporary address will be care of American Consulate, Bangkok, Siam.

George B. Holderer will be in Cuba for the next few months, with headquarters at the Horter Bldg., Obispo 7, Habana, Cuba.

William Loeb, Jr., has been elected a director of the Federal Smelting and Refining Co., succeeding William J. Hall, resigned.

S. F. Shaw has returned to Charcas from a visit of inspection to the Bonanza, Asientos, and Zacatecas units of the American Smelting and Refining Co.

Kenneth J. Duncan, representative of the Whiteside Minnesota mining interests, has returned from Minneapolis, where he underwent a serious operation.

Henry M. Adkinson has returned to Salt Lake after an absence of three months in New York, Washington, and Chicago, where he was engaged in professional work.

Walter Douglas, president of the Phelps Dodge Corporation, is making an inspection of the company's properties in the southwest, being recently at Douglas Ariz.

F. G. Lasier, who served as a captain of engineers in Washington until receiving his discharge recently, will resume his consulting work, with Detroit as his headquarters.

A. W. Allen has resigned from the editorial staff of the "Journal" to become chief engineer for the Penyon Syndicate. Mr. Allen expects to leave New York for Chile about the middle of June.

J. E. Spurr, executive of the War-Minerals Investigation, will be in charge of the physical examinations for the War-Minerals Relief Commission. A part of his field force is already at work.

W. A. McCurdy, formerly assistant general superintendent in the Vermillion district for the Oliver Iron Mining Co., succeeds **G. H. Dormer** as assistant general superintendent at Virginia, Minn.

W. P. Chinn, assistant general manager; **W. H. Gallagher,** mechanical engineer, and **W. A. Rose,** chief mining engineer, all of the Pickands-Mather Co., attended the annual meeting of the company, held at Cleveland.

A. S. Howie is expected to return to Lima, Peru, soon. He was formerly superintendent of the Natividad mines, at Morococha, and went to England in 1917, obtaining a commission in the Royal Engineers.

W. H. Overpeck, superintendent for the Oliver Iron Mining Co. in the Buhl district, has been transferred to the Hibbing district with the same company. He is succeeded by **G. H. Dormer,** recently of the Virginia district.

Frank J. Tone has been elected president of the Carborundum Co., of Niagara Falls, succeeding the late Frank W. Haskell. **George R. Rayner** succeeds R. B. Mellon as vice-president. **F. H. Manley** retains the position of treasurer.

Richard Coombs has resigned his position as mining captain of the Hancock Consolidated Mining Co., having been with the company for 13 years. Mr. Coombs was one of the "safety-first" leaders in the copper-mining industry.

George A. Chapman, of New York, consulting engineer for the Minerals Separation, Ltd., is in the Lake Superior district, in connection with the operation of the corporation's contracts with Calumet & Hecla and other interests.

Carl Wirth, formerly of the Research Corporation, who served in France as a second lieutenant with the 52d Regiment, has accepted the position of foreman in the smeltery department of the chrome plant of the U. S. Smelting, Refining and Mining Co.

James P. Graves, of Boston, has been in Salt Lake City, from which place he made inspection trips to the Bingham properties of the Bingham Mines Co. and the Eagle & Blue Bell and Victoria, of Tintic, also controlled by the Bingham Mines Company.

J. P. Bonardi, assistant chemist with the U. S. Bureau of Mines, who has spent several months in Seattle experimenting on flotation problems in conjunction with **Will H. Coghill,** has returned to Golden, Colo., to resume his duties at the experiment station there.

George Reading, chairman, **Alexander McNabb,** and **Sir David Paulin** of Edinburgh, Scotland, of the board of directors of the Arizona Copper Co., Ltd., accompanied by general manager **Norman Carmichael,** are visiting other Southwestern mining camps, after inspection of their company's mines and plants at Clifton, Morenci, and Metcalf.

A. E. Drucker has severed his connection with Howard, Morinni & Co., Inc., and opened an office on May 1 at 30 Church St., New York, where he will again take up the practice of a consulting metallurgical engineer. Mr. Drucker has organized the Drucker Smelting Corporation, of which he is president and treasurer. The purpose of the company is the recovery of metals from foundry residues.

Ira B. Jerolemon, geologist for the Calumet & Arizona Co. at Warren, who has been doing important work correlating the functions of artillery and airplane forces, has been recently released from Army service. Among other Arizona mining men recently discharged from the service are the following: Lieut.-Col. John C. Lowe, efficiency foreman of the Old Dominion mines at Globe, commissioned a lieutenant and promoted for good work at the front with the engineers; Lieut.-Col. H. H. Stout, superintendent of the Copper Queen smeltery at Douglas, for two years in the Ordnance Department and lately returned from overseas. Of the United Verde staff at Jerome, Clarence V. Hopkins, chief engineer, was one of the last engineer captains commissioned, and H. DeWitt Smith, superintendent, assigned to aviation service at Dayton, Ohio, was turned back on arrival.

LIEUT. WILLIAM H. STUART

The American Red Cross wishes to ascertain the whereabouts of Lieut. William H. Stuart, son of Duncan C. Stuart, of 12 Maple St., Oneonta, N. Y., and will appreciate any information that can be secured relative to him. Lieutenant Stuart is 27 yrs. old. He arrived from overseas service on Jan. 13, and went to Washington, where he was given his discharge. He returned to New York, and was last seen in that city Jan. 18, at 7:30 P. M. He is a graduate of Colgate, Class 1914, and took two years' post-graduate work at Brooklyn Polytechnic Institute. He is 5 ft. 8 in. tall, has dark brown hair and blue eyes and a ruddy complexion. He has a brown mole on the left side of his nose. He had three gold service chevrons on his sleeve, indicating 18 months' service overseas, if in uniform. When last seen Lieutenant Stuart was wearing spiral puttees, and not the customary leather ones for officers. Information relative to him may also be sent to D. C. Stuart, 13 Maple St., Oneonta, N. Y., or to Thomas Blizard, Chief of Police, Oneonta, New York.

Obituary

G. Lavignino, who had been engaged in mining operations at Bingham, Utah, for over 25 years, died on Mar. 21 in Los Angeles, at the age of 70 years.

Daniel H. Merritt, for many years active in the railroad and mining industries of the Lake Superior district, died at Marquette, Mich., on Apr. 28, aged 85 years. After a first visit to the district in 1855 he returned to Marquette three years later and was identified with the old Iron Mountain R.R. and later with the Marquette, Houghton and Ontonagan R.R., of which he was general manager. In 1868 he became connected with what is now the Lake Shore Engine Works at Marquette, Mich., and remained as its head until 1889. During his connection with this plant Mr. Merritt built the first stationary engine in the Lake Superior region.

Barry H. Jones, a director and secretary of the Bethlehem Steel Co., died on Apr. 3, being suddenly stricken while in the midst of his work. He was within six days of being 45 years old, and in years of service was one of the oldest of that coterie of men known as "the Bethlehem Boys." He was graduated from Lehigh University in 1894, as a bachelor of science in metallurgy. The following year he received the degree of engineer of mines for post-graduate work performed while acting as instructor at Lehigh. He entered the employ of the Bethlehem Steel Co. in 1899, which was about the time of its organization. He rose rapidly, and, because of his great ability in accounting and financial matters, he was made comptroller and auditor in 1902, and later in 1906 was elected a director, and the secretary and treasurer. He resigned as treasurer in 1917.

Societies

Engineers' Society of Western Pennsylvania, civic section, held the bimonthly meeting on May 6, when S. H. McKee presented a paper on "Central Boiler Feed Water Service for Plants."

American Institute of Mining and Metallurgical Engineers, Colorado section, held a meeting at the Denver Athletic Club, May 1, 1919. Following an informal dinner, Col. Thomas B. Burbridge addressed the section on "Travels Through Mining Districts in the Orient." The meeting was well attended.

Colorado Scientific Society held its 336th regular meeting at the Shirley Hotel, Denver, on May 3, 1919. The speaker was Prof. O. A. Randolph, who addressed the meeting on the subject: "The Production and Uses of X-Rays, With Special Reference to Crystal Structure." About 40 members and guests were present. The lecture was illustrated by lantern slides and laboratory experiments.

American Zinc Institute will hold the annual meeting at Hotel Statler, St. Louis, Mo., June 9, at 10 a.m. The postponement of this meeting from May 12 was occasioned by the crowded condition of the Statler's calendar of events. William F. Rossman, Pierce Bldg., St. Louis, is the chairman of the committee of arrangements. It is suggested that the matter of hotel accommodations at St. Louis be given early attention. Two days (Monday and Tuesday) will probably be devoted to the business of the Institute, including the election of directors, and the proceedings should prove of great interest to everyone engaged either directly or indirectly in the zinc industry.

The American Institute of Mining and Metallurgical Engineers will hold its annual convention in Chicago, Sept. 22 to 26. This meeting promises to be one of decided importance to the industry, as subjects of vital concern to modern metallurgy will be discussed. In addition to the technical talks, an elaborate social programme is being arranged, and excursions by the Institute as a body are planned to many points of interest in the vicinity, including the steel mills at Gary, the oil refineries at Whiting, metallurgical plants at East Chicago and North Chicago, and to the La Salle district, where the cement, coal, and zinc industries are represented. New York section, held a meeting on May 7 at the Machinery Club. The program was an address by Col. O. B. Perry, on the organization and campaign of the 27th Engineers in France.

Industrial News

Metal Export Company of America, New York, desires to announce removal to 220 Fifth Ave. on May 1. Telephone, Madison Square, 4794.

Greene, Tweed & Co., 109 Duane St., New York, has just issued a catalog which has the additional value of being a guide-book to the use of packings. The company will be glad to send a copy upon request to anyone interested in the difficult subject of piston-rod packings.

John Herman, assayer and chemist, has removed his business to 339 South Los Angeles St., Los Angeles, Calif. Announcement is also made that a 40-ton custom grinding plant is being operated at Vernon, a suburb of Los Angeles, and a plant will soon be installed to follow the Herman mill for making carload tests. The crushing plant is provided with railroad facilities.

Eagle-Picher Lead Co., Chicago, announces that H. G. Clopper, general sales manager of the New Jersey Zinc Co., has resigned from that company to accept a vice presidency in the Eagle-Picher Lead Co., and that he will actively begin work with this company on June 1 of this year. Mr. Clopper will make his headquarters at the general offices of this corporation in Chicago.

Joseph Dixon Crucible Co., of Jersey City, N. J., manufacturers of lead pencils, crayons, erasers, silica, graphite paint, crucibles, graphite greases, and graphite automobile lubricants, have announced the removal of their Philadelphia sales office from 1020 Arch St. to Rooms 801 and 802 of the Finance Bldg., South Penn Square, Philadelphia, May 1st. The Philadelphia sales district comprises Pennsylvania, Southern New Jersey, Delaware, Maryland, the District of Columbia, Virginia, and West Virginia. W. G. Stringer is in charge of the Philadelphia organization.

Anniston Steel Co., Anniston, Ala., has secured the services of N. W. Tarleton in the salvage division of the sales department. Mr. Tarleton was connected with the Southern Manganese Corporation of Anniston for the last two years as purchasing agent and traffic manager. He will now be in charge of the sale of all the equipment recently acquired by the steel company from the Illinois Car and Equipment Co., consisting of iron- and wood-working machinery of all kinds, engines, boilers, and other miscellaneous equipment the value of which has been estimated at slightly under $200,000. A catalog giving full information on the equipment to be sold is now in the hands of the printer, and will be distributed to the trade as soon as it comes from the press.

Pioneer Rubber Mills is the name under which the Bowers Rubber Works, of San Francisco, is now operating. The change in name became effective Apr. 1, but the management and policy of the company continue as under the old name. The Pioneer Rubber Mills will continue all the brands, such as Skookum Piston Rod Packing, Copper Queen Belting, Victor Fire Hose, that the Bowers Rubber Works has established. The Pioneer Rubber Mills maintains factory sales offices in Portland, Tacoma, Seattle, Los Angeles, Salt Lake, and Denver, and has distributors all over the United States. George N. Towne is vice-president and general manager, and D. D. Tripp is vice-president in charge of sales. The general offices are at 68 Sacramento St., San Francisco.

"How Business With Foreign Countries Is Financed" is the title of a pamphlet just issued by the Guaranty Trust Co., of New York, for the benefit of exporters and importers and others having business or financial relations with foreign countries. The brochure contains 28 reproductions of specimen forms of drafts, letters of credit, bills of lading, invoices, and other documents generally used in connection with the financing of exports and imports. Explanatory notes accompany each illustration, and features in the documents of particular importance are noted. The use of the documents is also explained when that seems necessary. Special attention is given to those which bear directly upon the development of dollar exchange. The pamphlet is printed in attractive type upon coated paper and is carefully indexed. At the end there is a table of currencies of various countries and their value in United States dollars.

New Patents

United States patent specifications may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

Aluminum. Apparatus for Carrying Out Processes of Winning Metals. Victor M. Weaver, Harrisburg, Penn., assignor to Weaver Co. (U. S. No. 1,296,575; Mar. 4, 1919.)

Anodes. Process for Making Anodes of Solid Manganese Peroxide. Max Huth, Berlin-Charlottenburg, Germany, assignor to Siemens & Halske, A. G., Berlin, Germany. (U. S. No. 1,296,188; Mar. 4, 1919.)

Cement-Making Process. Woolsey McA. Johnson, Hartford, Conn. (U. S. No. 1,297,297; Mar. 11, 1919.)

Concentrator. Arthur Baring-Gould, Placerville, Calif. (U. S. No. 1,296,737; Mar. 11, 1919.)

Copper. Process of Extracting Copper From Ores., Etc. Newton Evans, Los Angeles, Calif., assignor of one-third to Carl F. Schader and one-third to William H. Heady, Los Angeles, Calif. (U. S. No. 1,297,670; Mar. 18, 1919.)

Crushing. Grinding Mill. Jacob K. Griffith. Pittston, Penn., assignor to A. J. Griffith, Pittston, Penn. (U. S. No. 1,295,482; Feb. 25, 1919.)

Crushing. Mill. Thomas J. Sturtevant, Wellesley, Mass., assignor to Sturtevant Mill Co., Harrison Square, Mass. (U. S. No. 1,296,134; Mar. 4, 1919.)

Crushing. Rock Crusher and Pulverizer. Charles O. Michaelsen, Minneapolis, Minn., assignor, by mesne assignments, to Michaelsen Machinery Co. (U. S. No. 1,297,385; Mar. 18, 1919.)

Drill. Core Drill. Frank Miller, New York, N. Y. (U. S. No. 1,297,889; Mar. 18, 1919.)

Drill. Rotary Boring Drill. Robert E. Carmichael, Damon, Tex. (U. S. No. 1,295,969; Mar. 4, 1919.)

Drill Holder. John M. Calderwood, Spanish Fork, Utah. (U. S. No. 1,296,918; Mar. 11, 1919.)

Drilling. Oil-Well-Drilling Drive. Victor York, Brea, Calif. (U. S. No. 1,297,289; Mar. 11, 1919.)

Drilling. Well-Drilling Tool. John Maier, Detroit, Mich. U. S. No. 1,297,708; Mar. 18, 1919.)

Electric-Arc Furnace. Jens Lassen la Cour, Christiania, Norway, assignor to Norsk Hydroelektrisk Kvaelstofaktieselskab, Christiania, Norway. (U. S. No. 1,296,194; Mar. 4, 1919.)

Electric Furnace and Method of Operating the Same. Jervis R. Harbeck, New York, N. Y., and Edward G. Norton, Chicago, Ill. (U. S. No. 1,295,309; Feb. 25, 1919.)

Electric Furnace for Smelting Ores. Albert E. Bookwalter, Coeur d'Alene, Idaho. (U. S. No. 1,297,641; Mar. 18, 1919.)

Flotation. Apparatus for the Concentration of Ores. James M. Hyde, Palo Alto, Calif. (U. S. No. 1,296,190; Mar. 4, 1919.)

Furnace. Open-Hearth Furnace. Marinus Hvid, Chicago, Ill. (U. S. No. 1,296,189; Mar. 4, 1919.

Galvanized Sheet and Plates, Process of Finishing. Robert Skemp, Scottdale, Penn., assignor to American Sheet and Tin Plate Co., Pittsburgh, Penn. (U. S. No. 1,297,265; Mar. 11, 1919.)

Editorial Correspondence

BUTTE, MONT.—May 3

Anaconda Copper Mining Co., has instituted a contract system for the mining of ore as a measure designed to promote efficiency. Heretofore the contracts were given only for development work. However, since signing of the armistice, the efficiency of the miner has increased from 20 to 33⅓%, and the company is now mining 1½ tons per man. Anaconda is continuing operations at approximately 60% of normal, with a slight increase in the zinc ore tonnage. One of the most recent notable ore developments was the uncovering of ore on the 3200 ft. level of the Steward mine showing a width of 25 ft. and averaging about 5% copper and about an ounce of silver for each per cent. of copper. This width was found in the eastern part of the property; westerly, the drift on this level has been pushed 800 ft., showing eight to nine feet of ore for the entire distance. The Steward shaft, being sunk to the 3800 ft. point, is now down 3400 feet.

DENVER, COLO.—May 3

The Sunnyside Mine, at Eureka, in San Juan County, was recently the scene of a fire which destroyed the mine buildings with the exception of the transformer house. The loss is estimated at $250,000. Over 200 miners were without shelter, and lost their personal belongings. The bunk houses destroyed were steam-heated, electric lighted, and equipped with hot and cold running water. They were among the best mining bunk houses in the West. The cause of the fire has not been determined.

The Globe Smeltery at Denver is to be abandoned. The American Smelting and Refining Co. purposes handling at its Pueblo plant all Colorado ores which would come to this plant. Denver will lose the benefits of the payroll, and other incidental advantages of such an industry. The Globe smeltery is an old, out-of-date plant which has received few improvements. Its methods are in many respects obsolete. On the other hand, the Pueblo plant is modern, and has kept pace with improvements in smelting practice. Ore shippers, particularly those in the northern part of the state, are wondering if the change will have any effect upon the cost of selling their products, and whether the advantages to be gained by the smelting company will be permitted to offset the disadvantages to the shipper of the longer freight haul.

Junking Railroads is becoming general in Colorado. The most recent proposal is to junk the D. B. & W. R.R., known as the "Switzerland Trail." Such action would be of serious consequence to mine operators in Boulder County. This mountain railroad is absolutely essential to the proper conduct of the mining business in certain territory west of Boulder, and the mining business of this territory is of great importance to the trade of the city of Boulder. Mine operators of the district claim that motor-truck transportation of ore, coal and heavy freight in this region is not feasible and commercially practicable except in a few instances. It is claimed that if the road is discontinued the mines of the region will close, and with the junking of the railroad will follow the junking of mining plants and the abandonment of mining properties in which investments have been made which aggregate many times the amount invested in the railroad. It is claimed that this road brings in much of the ore which is delivered to the sampling works recently established at Boulder. The Yellow Pine Mining and Reduction Co., the Logan Metals Co., the Humboldt Mining Co., and many others have been active in filing protests with the Public Utilities Commission against the proposed junking of the railroad. The City Council of Boulder, and citizens of the camps served by the road, have taken up the issue and will make every effort to save the road for Boulder County.

HOUGHTON, MICH.—May 3

Copper Shipments by Express are not unusual from the Michigan smelteries, notwithstanding the generally depressed condition of the metal market and the surplus of copper in warehouses. These shipments are small lots. One went out from Hubbell yesterday, 1900 lb., to the American Brass Co.'s plant at Kenosha, Wis. This indicates the conditions of stocks carried by such plants.

Depression in the Copper Industry is marked in the Lake Superior district. More mines are considering suspension and others are figuring on further curtailment. Such properties as the Mass Consolidated, Victoria, and White Pine, in Ontonagon County, are continuing to operate. They are running at a loss, and though their total output of copper makes practically no appreciable difference to the surplus on

hand, it causes a continuous and sustained drain on the treasury.

Among the Calumet & Hecla subsidiaries, the White Pine is not the only producer which is operating at a loss. The Centennial, La Salle, and the Old Osceola branch of the Osceola Consolidated are today operating without profit. The same is true of the Superior. The margin is slim at the Allouez and the Isle Royale.

The Quincy, Copper Range, Mohawk, and Wolverine are independent producers which are going ahead full time in an effort to keep their working forces from joining the exodus to Flint, Detroit, and other automobile centers, which just now are augmenting their working forces by importations from the Michigan copper and iron industries. During the last week eight iron mines closed down in northern Michigan.

Two plans are generally discussed in the Michigan copper district to bring about alleviation of the distressing situation in which the copper producers now find themselves. One is to ask for a Government subsidy to copper mines, on the same plan that the wheat farmers now enjoy a subsidy. The other is to start a national advertising campaign to bring about more general use of copper. "Buy a Bar of Copper" may become a slogan as common as "Buy a Bale of Cotton" was a few years before the war.

(By Telegraph—May 5)

Production Reduced 50% and 2000 employees of Calumet & Hecla and subsidiaries are laid off by an order which was issued today. The properties affected are the Ahmeek, Allouez, Isle Royale, Osceola, and Lake Superior Smelting Co. All other men will work full time.

BISBEE, ARIZ.—May 3

Copper Camps of Cochise County show little change in the last 30 days. At Johnson two of the smaller properties are doing development work, the Arizona United, Copper Chief, and Mammouth Lease having closed down Feb. 1. It costs these companies about 18c. per lb. to mine copper, so the properties will undoubtedly remain closed until the price goes above that figure. At Gleeson, Courtland, Tombstone, and the other small camps where it costs the companies as much or more to produce copper than at Johnson, operation has been discontinued with the exception of that conducted by lessees, all of whom are taking out a small amount of ore. At Bisbee the situation looks better, the companies hiring a few machine men each day.

Settlement of Deportation Suits, according to the attorneys of the deported men, was attempted by the companies, which, the report states, offered to settle with men in the district so deported, on the following basis: Single men, $500; married men without children, $1000; married men with children, $1250. Deported men will take a vote on this offer, but it is reported that they are not inclined to accept. In this connection, the indictments which had been found in the Bisbee deportation cases, involving about 25 individuals, including capitalists, mine operators and public officials, were quashed by Judge William W. Morrow, of San Francisco, in a decision filed on Dec. 2 in the U. S. District Court. The indictments charged conspiracy to deprive citizens of the United States of their constitutional rights and involved the deportation of 1186 striking copper mine workers and their alleged sympathizers.

Readjustment of Rates on copper-ore shipments from Arizona mines to reduction works in this state and other sections was asked of the Interstate Commerce Commission today by the Calumet and Arizona Mining Co. and the Phelps Dodge Corporation. It was claimed that such readjustment was necessary to meet the competition of the Anaconda and other copper companies. The rate relationship of those rates, it was stated, was disturbed by the advance of 25% in freight rates put in effect by the Railroad Administration.

Announcement that the Interstate Commerce Commission has refused the request of Director-General Hines to reopen the Michigan rate case was made recently. The Director-General requested the reopening on the ground that the whole structure of railroad rates was in danger of concerted action against the charges on the part of the shippers. A decision already has been handed down in these cases, the commission said, and no additional proof or data have since been submitted to warrant the reopening of the cases for further argument and consideration.

ST. LOUIS, MO.—Apr. 29

The Southeast Missouri Lead Belt has greatly restricted the output of lead, on account of the low price of pig lead in St. Louis, which today is selling at 4¾ to 5c. per lb., which is abnormally low in view of the continued high price for labor and supplies. The excessively high wages of the war boom have been reduced only 20%, which reduction was accepted by the miners without trouble. The St. Joe Co., the heaviest producer, has entirely closed down its large Leadwood mill and mine, but is operating its Bonne Terre and River Mines plant on full time. Its smeltery at Herculaneum has been closed down for some time, as it is being remodeled and will probably not start again until autumn. In the interim, St. Joe smelting is being done by the Collinsville and Alton smelteries, in Illinois. To reduce the cost of living, the St. Joe Co. has reopened its mine store at Bonne Terre, where it is selling groceries at a marked reduction below prices asked by local storekeepers. The new tailing stacker at Bonne Terre is now in successful operation, with a saving of approximately $100 per day over the large crew that was formerly required when it was the practice to haul these tailings away in railroad cars to nearby dumps.

The Federal Lead Co. is operating only two of its eight shafts, and has closed down the new No. 4, 3000-ton mill. Only a few diamond drills are operating, whereas usually at this time of the year at least 40 to 50 should be at work on the summer campaign development work. The Hungarian miners are largely leaving the district rather than take out naturalization papers now required, and many of them had been employed for some time without attempting to take out their papers.

PIOCHE, NEV.—May 1

Activity in the Pioche District has been revived owing to the high price of silver, and has been under way since the first of the year. Recently a decided impetus was given by a notable strike in the Harney group of claims, in the eastern end of the district, by two lessees, Stindt and Donohue. About $20,000 worth of ore has already been shipped to the smelters. About the middle of April, Stindt and Donohue sold their lease to Melville Gillett, of Smethport, Penn., and G. Henry Stetson, of Philadelphia, Penn., for the sum of $75,000. The purchasers, who have also taken options on adjoining property, are preparing to install equipment to conduct extensive development work. The fact that the vein was previously unknown, owing to its outcrop being covered by soil, has stimulated interest in adjacent areas of undeveloped ground which lie within the mineral-bearing belt, and several leases have been let for the exploration of these areas.

The current price of silver now renders possible the exploitation of bodies of low-grade ore in producers that could not be profitably mined previously. One of these properties, the Providence Mines Co., has recently been purchased, for the sum of $10,000, by the Mascot Mining Co., of which the control is held by John Cook, of Pioche, and H. W. Rand, of Los Angeles. This property is fully equipped for operation and development. Large bodies of low-grade ore are known to exist in several of the principal producers of former days, now owned by the Amalgamated Pioche M. & S. Corporation. These orebodies, in accordance with the past policy of the company, will probably be leased.

A considerable proportion of the silver and lead in the Pioche ores occures in an oxidized form, and under the ore-dressing methods formerly practiced, of amalgamation and table concentration, rarely more than 50% or 60% of the metal contents could be recovered. The success attending the operations of the Prince Consolidated M. & S. Co. in treating old mill tailings at the Bullionville mill by flotation with the use of sulphidizing reagents has demonstrated that a high precentage of recovery on oxidized ores can be attained by this process; and a movement is under way, by residents of the district, to lease the concentrating mill of the Amalgamated Pioche M. & S. Corporation, which is equipped with Overstrom tables and Callow flotation cells, for use as a custom mill, for the treatment of the low-grade ores of the district.

In the southern part of the district, the Prince Consolidated M. & S. Co. and the Virginia-Louise Mining Co. are making regular shipments of about 25 cars and 10 cars, respectively, per week, to the Salt Lake smelters. The ore produced by these properties is a low-grade silver-lead ore, which, because of the fact that it contains between 30% and 40% iron and manganese in excess of the insoluble content, is a desirable smeltery flux. The two properties are contiguous, and are mining the same orebodies, which are of the bedded type, and are of large areal extent and thickness. During the last year a new orebody, known as the "Davidson," has been discovered, which is of exceptional purity and large size, having a thickness of 60 ft. in places.

BIRMINGHAM, ALA.—May 3

Gradual Reduction in the Iron Business in this district, noticeable since the beginning of the year, was still further marked when on Apr. 28 practically the entire mining division of the large companies went on an eight-hour basis. This means a large cut in wages and will particularly affect the small wage earners. The change affects the entire district more, probably, than any one event since the taking over of the Tennessee Coal, Iron and Railroad Co. by the Steel Corporation. The Sloss-Sheffield Steel and Iron Co. has been running on an eight-hour day, five days a week basis for some time, and this schedule will probably be followed by some of the other companies, at least at their smaller plants.

The Republic Iron and Steel Co. has closed all but one of its mines at Spaulding, this being run five days a week on an eight-hour basis. The ore from these mines has been going into stock, and with only the one mine in operation it is probable its output, too, will be added to the stock. This company's brown ore mines at Houston have been closed, but all construction now in progress will be finished, particularly the new washer now nearing completion. The company's No. 3 mine, at the Raimund group (R. F. D. No. 3, Bessemer, Ala.), is now being mined for hard ore only. The soft ore forming the largest proportion of this mine's production is not in demand at the company's furnaces at Thomas, and, as the hard-ore production is not great, it would not be surprising to see this mine closed entirely. The Nos. 1 and 2 mines of the Raimund group will probably continue to operate, as their entire product will be needed to supply the company's one furnace in operation (Thomas, Ala.). Two stacks of the group of three at Thomas are now idle, and though there is no indication of the third going out of blast, should it do so it will probably mean the closing of the company's Raimund and Spaulding groups of mines. Only four mines of the Tennessee Coal, Iron and Railroad Co.'s Wenonah group are working, two being run one day and two the next. All night work in the company's mining division has been discontinued, with the exception of that at the No. 6 mine in the Muscoda group.

It is rumored that the Woodward Iron Co. will begin operations soon. This is borne out by reports from a number of the other large companies that labor now leaving them in a majority of cases is returning to some of the Woodward plants and mines.

JOHANNESBURG, SOUTH AFRICA—Mar. 30

Rand Mining Industry was discussed at the annual meeting of the Transvaal Chamber of Mines, held on Mar. 24. Sir E. A. Wallers spoke on the relations of capital and labor in regard to fewer hours and the process of underground mining, and showed that the actual time for native laborers required in drilling rock which must be broken in order to maintain operations was surprisingly short. However, he said a decrease in dividends would occur unless the decreased hours and increased wages were accompanied by greater efficiency. Taking the Rand industry as a whole, it was now paying 2½% on the capital invested. No mine had closed down. The dividends amounted to only £5,144,077 last year, compared with £8,730,436 in 1914, and of the latter figure £6,357,933 was declared by mines other than those on the Far East Rand. In 1918 these same mines declared dividends of only £1,929,430, a decidedly small return on the capital invested. Working profits had decreased from 9s. to 6s. per ton, whereas total costs had increased from £21,943,692 in 1914 to £26,848,547 in 1918.

There was an insufficiency of native workers throughout the year. The refusal of Parliament to sanction the experimental introduction of 1000 tropical natives for work in the mines after being inoculated was not to the best advantage. The limited point in earning to which the natives were able to rise was the cause of dissatisfaction. A number of piecework systems was in use, and information was being collected as to such methods of payment, with the intention of extending them where possible, having proper regard for the position of white workmen. Despite the increase of the native death rate resultant from the influenza epidemic, the mortality from pneumonia among natives was at the rate of 3.72 per 1000, compared with 3.36 for 1917, which was the lowest on record. The accident death rate was only 2.68.

The Mining News

ARIZONA

Cochise County

TOMBSTONE MINES of Phelps Dodge Corporation operating only under leases; 150 men thus employed, profitably.

Gila County

GILA MONSTER (Globe)—New corporation formed to operate Mack Morris, Richmond and other old mines of Richmond Basin, nine miles north of Globe. District was notable silver producer in early 80's. New vein cut in Richmond at 70 ft.

Mohave County

FAY (Kingman)—Option taken by H. A. Hamme, who is remodeling small mill for run on ore from narrow vein carrying gold.

GOLD DUST (Oatman) — Exploring on 500 level, directed by H. E. Davis, geologist, to strike vein faulted below 300 level. About $500,000 spent on development.

MUSHRUSH (Oatman)—Taken over by United American Co., composed largely of stockholders in United Eastern. Lies just south of Tom Reed ground. Deep shaft to be sunk, with expectation of picking up Tom Reed lead, already being worked close to southern line. Hoist and compressor already in place.

Santa Cruz County

LAYMAN SYNDICATE (Patagonia)—Organized by James Layman and R. E. Moore, of Jerome, to take over Pierce-Gardner and Blue Nose properties. Former has shipped since December 27 carloads silver-lead ore. Orebody is about 12 ft. wide.

Yavapai County

UNITED ARIZONA (Cordes) — Completed shaft to 800 ft.; will sink winze on vein 200 ft. deeper. Commercial ore said to be developed.

DUNDEE ARIZONA (Jerome)—W. E. Defty, consulting engineer, of Phoenix, making plans for small leaching plant for surface carbonate ores estimated at 50,000 tons, sampling above 3% copper. Sinking 600-ft. shaft will be resumed; country now drained by Extension tunnel. Owns about only level land in Jerome, and laying off a townsite on which $150,000 school will be placed.

VERDE COMBINATION (Jerome)—On 1300 level two drifts cut 6-ft. ledge of schist carrying chalcopyrite. Drifts started along ledge.

SILVER BELT (Prescott)—New shaft driven 160 ft.; high-grade galena-silver ore struck in 9-ft. vein.

CALIFORNIA

Calaveras County

PARNELL (Angels Camp)—To install machinery and work gravel claim through shaft formerly sunk to bedrock. Jim Lee and associates have lease.

INDIAN CREEK (San Andreas)—Electric power, air compressor, rock crusher, and stamps and concentrator tested and ready for operation. Mines in this district idle for about eight years. Walter Osselin and Frank Cuneo operating.

Eldorado County

ELDORADO LIME (Latrobe)—Shipping five cars lime daily.

FRUIT RIDGE DISTRICT (Placerville)—W. W. Bender and Ray Danaher developed claim; installed machinery costing $5000, which will be increased immediately.

Humboldt County

HORSE MOUNTAIN COPPER (Eureka)—Examination under option held by Pittsburgh men to begin early in May. Mine developed and some copper concentrates produced. Concentrating plant, sawmill and other surface improvements and development work have cost about $250,000. Improvements include 12 miles of good road. Property produced large amount chrome ore.

Inyo County

KEARSARGE (Independence)—Optioned by Independence Mining and Milling Co. after idleness of 47 years. Was a producer of high-grade ore over 50 years ago. Discovered in 1864; a 10-stamp mill installed in 1866 at cost of $40,000. Was variously managed by Almarin B. Paul, Isaac L. Requa and D. P. Pierce. Mr. Paul said to have quit because one consignment of bullion he shipped assayed only 12½c. per oz. But other ore ran as high as $950 per ton in silver. P. C. Montgomery is manager of company just formed under laws of Minnesota.

Napa County

WHITEROCK MAGNESITE (St. Helena)—Operations resumed after idleness of several months. Motor trucks haul product to railroad.

Nevada County

MOUNTAINEER (Nevada City)—Action brought in Superior Court by Peter Bender, of Morgan Hill, Santa Clara County, to recover $118,338 on note executed in April, 1915. Situated on Deer Creek, second largest mining holdings in district.

Plumas County

ONION PLACER (Greenville)—To resume operation. Heavy snows insure abundance of water. Joseph Baccala and William Roedde, owners.

TRASK & COFFER (Taylorsville)—Compressor installed in Moonlight Canyon. Development discloses large deposits copper ore carrying gold and silver.

COLORADO

Boulder County

SLIDE (Gold Hill)—Milling ore opened on 800, 900 and 1000 levels. Mill running three shifts on ore from these levels, and from Slide dump. Concentrates shipped to local sampling works at Boulder.

BLACK ROSE (Jamestown)—Acquired by W. F. Dopp and associates; will begin development.

COLORADO PITCHBLEND (Jamsetown)—Employ 15 men in development. Golden Age mill, recently remodeled, treating 125 tons per day. Reported fluorspar product averaging 94% calcium fluoride; iron-lead concentrate treated by flotation.

NUGGET (Rowena) — Purchased by Omaha men; will develop soon.

PRUSSIAN (Rowena)—S. A. Tarbett & Co. developed milling ore. Prussian mill operating with flotation unit.

TIPPECANOE (Rowena)—Acquired by E. P. Copeland and associates, of Boulder. Cleaning tunnel and other workings preparatory to development.

Dolores County

RESOLUTE MINING CO. (Rico)—To operate new 100-ton concentrating plant. Expect to purchase all equipment soon. J. A. Houghton, 54 De Menil Bldg., St. Louis, Mo., president.

Gilpin County

IRON CITY MILL (Black Hawk)—John Mollard and associates, of Idaho Springs, secured three-year lease. Mill will be remodeled and flotation equipment installed. Plant will be designed to treat ores from the Becky Sharp, Lillian, and other mines in Russell Gulch, partly to save transportation charges on milling products. John Scibird, formerly superintendent at Argo mill, near Idaho Springs, will be in charge of mill.

IDAHO

Shoshone County

NABOB (Beeler) — Framework of new mill on Pine Creek completed. Most of machinery on ground and being installed.

CARBONATE HILL (Mullan) — Work started after suspension, owing to war conditions. Shaft down over 400 ft. Will crosscut vein at 400 level. Old workings show lead and zinc in 100-ft. vein, and some encountered in sinking shaft. Shaft sunk from lower tunnel. Modern hoisting plant in underground chamber. Will employ 25 men.

NATIONAL (Mullan)—Management announces mill will start after suspension of two months. Enough ore broken to run three months. New oreshoot of better grade, recently found on 800 level, will be developed.

HERCULES AND TAMARACK (Wallace)—Resumed operations after four months' suspension. Each working one shift until repairs at Northport smeltery are completed, to permit handling maximum product. Considerable difficulty experienced in getting the limited forces required.

MICHIGAN

Copper District

MOHAWK (Mohawk) — Openings in lower levels No. 6 shaft not in as good rock as those of 4 and 5. This is similar to past occurrences. No. 6, 15th level, in 470 ft. south and 490 ft. north. South opening at 14th level in 401 ft., north 500 ft. North drift at 12th level in 135 ft. and south 117.

SENECA (Mohawk)—Crosscut struck vein 35 ft. from shaft; in 21 ft. and no hanging wall yet in sight. Crosscut is 8 x 9 ft. not exactly at right angles, owing to rake of shaft.

COPPER RANGE (Painesdale)—Baltic's deepest shaft is No. 3, at 3500 ft.; newest openings show copper rock averaging 32 lb., after selection. Continues shaft sinking. No. 4 shaft down 3000 ft., No. 2, down 2900 ft. During 1918 the Baltic drifted a total of 11,991 ft., including work on west lode, subdrifting 164 ft., crosscutting 965 ft., and raising 663 ft. Total tonnage hoisted was 422,035. Stamped 293,601; waste, 128,484, or 30 per cent.

Gogebic Range

NORRIE-AURORA (Ironwood) — Drill-sharpening shop, 40 x 40 ft., completed. Has four oil forges, sharpening machines, puncher, oil temper tank, and drill racks.

Menominee Range

DUNN (Crystal Falls)—Shut down completely; only pumps running.

ODGERS (Crystal Falls)—Shut down completely; only pumps running. Thus all McKinney Steel Co. mines in Iron County are down, the Tobin (Crystal Falls) and Tully (Stambaugh) having closed in January. Between 400 and 500 men have been let out at these properties, and others in county are curtailing operations.

WEST CHAPIN (Iron Mountain)—Planning to erect charcoal blast furnace. Ore low in phosphorus, but low in iron also; has not been a shipper.

MINNESOTA

Cuyuna Range

MANGAN No. 1 (Ironton)—Closed down pending betterment of ore market; 10,000 tons manganiferous ore in stockpile.

PENNINGTON (Ironton)—Open pit of Tod-Stambaugh shipping.

JOAN No. 4 (Trommald)—Marcus L. Fay property closed down, as unable to pump water required when surrounding mines closed.

Mesabi Range

CLARK (Chisholm)—Rushing operations to exhaust ore before expiration of lease, which occurs this year. Estimated 500,000 tons still available.

SHENANGO (Chisholm) — Shut down May 1, releasing about 100 miners. One of oldest properties on range, in continuous operation since original shaft sunk, in 1901. Operated by Shenango Furnace Co. which will ship some ore from open-pit portion.

LEONIDAS (Eveleth)—Washing plant being installed by Oliver Iron Mining Co. nearing completion; all material on ground. A feature is a 35-ft. log washer and 60 x 48-in. jaw crusher.

MORRIS (Hibbing)—New crushing and screening plant in operation Apr. 16.

BRAY (Keewatin)—Closed down May 1, account uncertain ore market. Operated by Republic Iron and Steel Co.

STATE MINES (Mesabi District)—Shipments to Apr. 26 totaled 107,351 tons, divided as follows: Pool, 1350; Hill Annex, 3895; Philbin, 6055; Wanless, 8832; Leonidas, 16,605; Shiras, 24,150; Missabe Mountain, 46,464.

LA RUE (Nashwauk)—Will not start washing ore until about June 1.

YORK (Nashwauk) — Began shipping Apr. 28. Crosby, same district, began shipping May 1.

MONTANA

Beaverhead County

BOSTON & MONTANA DEVELOPMENT (Elkhorn, via Divide)—Two raises from Idanha fissure on 1000 level showing high-grade ore up to as high as driven, approximately 200 ft; tops of raises being connected by drifting, with ore exposed all the way. Ore carries gold, silver, lead, copper, and zinc. Blocking out ore preparatory to shipment when Montana Southern Ry., now under construction, has reached Elkhorn. Railway a subsidiary of company. Samuel Hall, superintendent.

Jefferson County

PLACER MINING in Montana City has begun on a bar bordering Prickly Pear Creek.

FREE COINAGE (Clancy) — Amalgamated Silver Mines Co. shipped four carloads during April.

LEGAL TENDER (Clancy) — Sacking high-grade silver ore for shipment.

ELKHORN QUEEN (Elkhorn) — Prospecting below 550 level.

Lewis and Clark County

POWELL COUNTY (Bald Butte)—Hydraulic and ground sluice work begun in Uncle Ben Gulch.

HELENA MINE (Helena)—New contact lead in south 400-ft. drift; higher-grade ore.

HELENA PLACERS (Helena)—Sinking 60-ft. shaft in Last Chance Gulch begun on West Main St.

Missoula County

POTOMAC COPPER (Potomac)—Ten teams building road to connect with Potomac highway, where connection is had with railroad. Two compressors purchased; compressor plant under way, preparatory to starting 1200-ft tunnel under "Copper Cliff" outcropping of quartzite carrying chalcocite and averaging about 2% copper. Irving W. Higgins, superintendent.

Powell County

MONARCH MINING (Elliston)—Installation of compressor plant under way; cutting mine timbers and mill construction proceeding. Employs 25 men. Development by tunnels. Frank Eichelberger, manager.

Silver Bow County

CRYSTAL COPPER (Butte)—Crosscutting and drifting on north and south veins on 500 ft. level. Second north fissure expected to be cut. Carload of ore will be shipped this week. W. D. Gibson, superintendent.

GREAT BUTTE COPPER (Butte)—Crosscutting and drifting on 2000-ft level on several fissures thus far failed to disclose ore and further financing of operations is in progress. F. W. Bacorn, superintendent.

NEVADA

Lincoln County

PIOCHE DISTRICT ore shipments during week ended Apr. 24 were: Prince Consolidated, 25 cars; Virginia-Louise, 7 cars; Harney (Stindt and Donohue lease), 2 cars; Consolidated Nevada-Utah, 1 car.

HARNEY (Pioche)—Stindt and Donohue lease. Headframe being erected and hoisting engine installed. Peter Buol in charge. Big Five lease: Struck extension of rich orebody recently discovered in adjoining Stindt & Donohue lease.

Nye County

Tonopah shipments for week ended Apr. 19 amounted to 7,099 tons, of estimated gross milling value of $120,683. Shippers were: Tonopah Belmont, 2052 tons; Tonopah Milling, 1100; Tonopah Extension, 1965; West End, 863; Jim Butler, 105; Montana, 277; Tonopah Divide, 420; MacNamara, 210; Midway, 34; Rescue, 63; and miscellaneous, 10 tons.

ALTO DIVIDE (Divide)—Large compressor in operation supplying air to Alto and East Divide, being under same control and adjoining. Joseph Mayer, manager; J. K. Turner, consulting engineer.

BROUGHER DIVIDE (Divide)—Installing larger machinery delayed work on 500 level. Southeast drift on this level, near center of vein, advanced 140 ft., large part of distance in good milling ore exposing some ore of shipping grade. Crosscut showed 22 ft. of milling ore. Another drift started northwest on Brougher vein.

DIVIDE CONSOLIDATED (Divide) — Two-compartment shaft sunk and timbered 50 ft.; second largest hoisting and air plant in district installed, including 10-drill compressor. Sinking resumed. Richard Finn, superintendent.

DIVIDE EXTENSION (Divide)—Shaft nearing 350-ft. point, and will crosscut through vein in this ground from adjoining Brougher. Vein here said to be in the area affected by block faulting, which brought lower breccia nearer surface, as in adjoining Divide mine. Good silver assays obtained from surface workings on knoll or blow-out 600 ft. north of main shaft.

EAST DIVIDE (Divide)—Using air drills, and shaft down 380 ft. Station will be cut for lateral work at 400-ft. point. Shaft cut silver ore stringers.

GOLD ZONE (Divide)—Machinery for larger surface plant arriving; shaft will be sunk from 500 to 800-ft. point at once. Seams of ore cut in southeast drift on 500 level; northeast crosscut on this level, from shaft, penetrated separate vein or fracture zone, trending more to east and showing seams several inches wide.

SUTHERLAND DIVIDE (Goldfield) — Owns 135 acres, five miles from Tonopah in Divide district. Installed plant and started development; power turned on Apr. 24; working two shifts in 400-ft. shaft sunk in days of Tonopah boom, now in good condition. Will explore 300 level and sink shaft 200 ft. deeper for lateral extensions.

TONOPAH DIVIDE (Divide)—Fourth, or 465 level, hanging wall drift advanced southeast 250 ft., near point under high-grade sill on third level, where chamber 20 x 50 ft., 10 ft. high, produced ore showing high contents. Lower drift continues in ore, some being high grade. Raises from second and third levels connected with drifts above, all in high-grade ore. Shaft sunk to 565 level, where station cut, and south crosscut will be started to vein soon. Now awaiting completion of foundations for 1200-cu.ft. compressor, purchased from Goldfield Merger Mines, and large double-drum hoisting engine. Latter will be installed when next level opened. Time lost in these improvements will be recovered with increased air supply. Shipments to MacNamara mill, at Tonopah, are 60 tons daily. Mill construction will be considered when water level is reached.

TONOPAH DIVIDEND (Divide)—Shaft being sunk below 300 level; electrically driven hoisting engine being placed at shaft collar, replacing gasoline engine. Equipment includes electrically driven compressor. E. P. Cullinan in charge.

NEW MEXICO

Grant County

CHARLES FOWLES, Lordsburg, owner and superintendent of silver-lead mine at Old Hachita, will purchase new pumping plant, including power equipment to handle 250 gal. per minute.

APACHE MOUNTAIN (Hachita) — Anderson Apache Copper Mining Co. reopened silver-lead properties four miles south of Hachita. Shipped one car ore to El Paso smeltery in April. Robert Anderson superintendent.

OLD HACHITA (Hachita)—O. O. and E. Mattox and Charles I. Auer took over Tom Wright interests and acquired additional ground. Shipped one car silver-lead ore to El Paso smeltery last month, and will ship another soon.

BOSTON HECLA (Lordsburg)—Situated three miles southwest of Lordsburg, in charge of R. E. Van Druff. Open for contract to sink a two-compartment shaft 260 ft. below 40 ft. level. Raw timber so far secured.

UTAH

Juab County

TINTIC SHIPMENTS, week ended Apr. 25, amounted to 134 cars.

CHIEF CONSOLIDATED (Eureka)—Report to Board of Equalization of net proceeds for 1918, $773,737, which multiplied by three is $2,321,211 as basis for taxation. Machinery and improvements, $113,210. Gross yield from 66,019 tons of ore produced, $2,956,601, from which deductions of $1,055,780, cost of extraction, reduction, transportation, and construction. Metal content, 4100 oz. gold; 2,354,798 oz. silver; 7,906,831 lb. lead; 4137 lb. copper; and 14,597 lb. zinc.

IRON KING (Eureka)—In east Tintic property. Purchased compressor and hoisting plant. Has iron ore suitable for fluxing which it may market on completion of Goshen Valley R.R. Also seeking to develop other ores. Near Tintic Standard.

TINTIC DRAIN TUNNEL (Eureka)—Now completed for 2500 ft. Again in softer ground and timbering necessary.

Salt Lake County

COLUMBUS-REXALL (Alta) — Gross yields 1918 amounts to $153,568; net proceeds, $41,485. Machinery, $14,932.

OHIO COPPER (Bingham)—Report to State Board of Equalization for 1918 shows production of 3,442,647 lb. copper; gross yield $861,926, and deductions, $894,701, making deficit, $32,744. Extraction, $219,934; reduction expense, $584,070; transportation, $90,696.

UTAH CONSOLIDATED (Bingham) — Gross yield for 1918 equals $2,827,571; deductions, $2,571,060, leaving net proceeds $256,511. Machinery valued at $241,010; buildings and tramway at $87,400.

WASHINGTON

Whatcom County

CANADA OIL AND VENTURE CO. (Vancouver, B. C.)—Has let contract to Diamond Drill Contracting Co., 419 1st St., Spokane, Wash., to continue a hole now 2640 ft. deep to 3500 ft. Object is to prospect for oil or gas. Hole is at Enterprise station on Great Northern Ry., 2½ miles north of Ferndale, Wash.; was started about five years ago.

CANADA

British Columbia

INTERNATIONAL MINING CONVENTION will be held at Nelson, June 19-20-21. Government aiding project, subscribing $2500.

Ontario

IN BOSTON CREEK SECTION the mines are negotiating with Northern Ontario Light and Power Co. for electric power. Power line passes practically through the camp, and only substation and distributing lines required.

ADANAC (Cobalt) — Has made another discovery of high-grade ore in new vein.

CROWN RESERVE (Cobalt)—Installed underground electric haulage system; only one of its kind in Cobalt.

T. & H. B. (Cobalt)—Surrendering charter as result of formation of operating company known as Hudson Bay Mining Co. The T. & H. B. was first company to take holdings in Cobalt and first to pay a dividend, which was 200%. Was capitalized at $25,000 and only 7,761 shares of $1 par issued. Stock at one time difficult to dispose of at 10c. a share, ultimately sold at $375. First mining work done was to sink shaft. First 65 ft. of sinking returning $55,000 worth of ore.

GOLD REEF (Porcupine) — To be reopened.

MEXICO

Estado de Sonora

CACHARAMBA (Alamos) — Owned by Plata Fina Mining and Development Co. Has completed 3000 ft. of development work, blocking out $50,000 medium-grade silver-copper ore. Completed truck road to Navajo, 35 miles. Will start shipments in 60 days. T. P. Brinegar, superintendent.

PIEDRAS VERDES (Alamos) — Has 2500 acres low-grade copper ore, 25 miles from Alamos, under option to New York parties.

CHOSEN

ORIENTAL CONSOLIDATED (Unsan)—April clean-up, $400,000. Clean-up for March as follows: Tabowie Mill, 11,064 tons, yielding $32,675; Taracol, 10,258 tons, yielding $19,773; Taracol cyanide plant, $50,750.

Begun mailing bullion to Tokio, care of Dai Ichi Ginko, Ltd. Tanaka Choten taken contract, accepting company assay. The D. I. G. in Tokio collects value from purchasers before delivery of gold. Receiving 5.18 yen per momme for pure gold and 24 yen per momme for silver contents. Gold value is advance of 3.6% over par value of 5.00 yen per momme. Tanaka Choten deposited 10,000 yen as guarantee to accept gold at this rate for six months.

Epidemic of foot and mouth disease among the bulls practically over; quarantine lifted in latter part of March. Suribong dam should be completed by July if present labor force can be maintained, and no unusually bad weather hampers the work; expect farmer element to return to farms in few weeks, but hope to replace them with Chinese, who are coming in daily. Water was turned through tunnel on Mar. 22, lowering river several feet, helping work of excavating and stripping to bedrock. Chorrie reservoir down to 6½ ft., and unless some rain falls, hydro-electric power will fail soon. No evidence here of political outbreaks by natives which occurred in other parts.

The Market Report

SILVER AND STERLING EXCHANGE

May	Sterling Exchange	Silver New York, Cents	Silver London, Pence	May	Sterling Exchange	Silver New York, Cents	Silver London, Pence
1	4.6650	101⅛	48 11/16	5	4.6725	101⅛	48 11/16
2	4.6700	101⅛	48 11/16	6	4.6800	101⅛	48 11/16
3	4.6700	101⅛	48 11/16	7	4.6813	101⅛	48⅝

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

DAILY PRICES OF METALS IN NEW YORK

May	Copper Electrolytic	Tin Spot.	Lead N. Y.	Lead St. L.	Zinc St. L.
1	15.35	†72½	4.72½ @4.77½	4.55 @4.60	5.95
2	15.35	†72½	4.72½ @4.77½	4.55 @4.60	5.95
3	15 35	†72½	4.72½ @4.77½	4.52½ @4.57½	5.92½
5	15.35	†72½	4.75 @4.80	4.47½ @4.57½	5.90 @5.92½
6	15.35	†72½	4.75 @4.85	4.50 @4.60	5.90
7	15.35	†72½	4.75 @4.85	4.50 @4.60	5.90

† Government price.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for the deliveries constituting the major markets, reduced to basis of New York, cash, except where St. Louis is the normal basing point.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other special shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for spelter are for ordinary Prime Western brands. We quote New York price at 35c. per 100 lb. above St. Louis.

LONDON

May	Copper Standard Spot	Copper Standard 3 M.	Copper Electrolytic	Tin Spot	Tin 3 M.	Lead Spot	Lead 3 M.	Zinc Spot
1	76	76¼	80½	226½	226	24½	24	35½
2	75¾	75¾	80½	226½	225¾	24½	24	35¼
3	....	....	....	....	....	....	....	....
5	75¾	76	80	226¾	227	24½	24	35
6	76¼	76½	80	227¾	228	24	24½	34½
7	76.35	76½	80	228½	228¼	24½	24.35	34¾

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb.

Metal Markets

NEW YORK—May 7, 1919

Copper was distinctly firm this week, and practically none was to be had except at the terms of the big producers. Lead was soft during the early part of the week, but was firmer toward the close. Zinc broke through the 6c. price and declined from day to day.

Important events of the week were the removal of all import licenses except with respect to tin and some minor substances; and the removal of the restrictions on the exportation of silver, which sets the silver market free to rise if demand and supply so determine, while, on the other hand, the replacement of the silver taken from the Treasury under the terms of the Pittman Act may guarantee the market against a decline below $1 per oz., or the net equivalent thereof. However, there is no certainty as to how things are going to work out.

Transatlantic freights became easier for shipments to British ports, 1c. per lb. being quoted. The rate to French ports is 1½c. The rate from Pacific ports to Hongkong and Kobe remains at $15 per ton.

Tuesday was a holiday in New York City, but the banks were open. Some of the business houses were open and some were closed. Considerable business in the metals was transacted, and we do not therefore regard the day as a holiday.

Copper—A rather fair volume of business was done, the total being rather more than in the previous week. This was mainly for domestic account and was mainly with wire-drawers. There was scarcely any business in cakes and ingots. Any business that might be done with brass makers is overshadowed by the large supplies of scrap that are offered, a good deal of it being high-grade scrap. There was some trifling export business, among which were some small sales to Japan. This produced the curious situation of Japan offering electrolytic copper in England at prices below ours, while, on the other hand, she is buying electrolytic copper from us. The explanation is probably that the offerings in England are from copper in stock there, or afloat thereto, while refining costs in Japan have risen to such an extent that it may have become cheaper to buy from us. It is not expected, however, that the Japanese demand will amount to much.

Domestic copper manufacturers report slack business. The copper that they are taking is mainly for maintenance work. The railways and public service corporations are not buying at all. Among the wire-drawers there is very keen competition, which sometimes leads to the sacrifice of the profit on copper that was purchased more cheaply a couple of months ago.

Copper Sheets—The base price of copper sheets is 22½c. per lb. Copper wire is quoted at 17½@17¾c. per lb. f.o.b. mill, carload lots.

Tin—American smelters decline to sell for future delivery, which indicates that some kind of protection has been promised. In the meanwhile, it is said that the stock of the U. S. Steel Products Co. is being allocated very slowly, and it may be the middle of June before it is disposed of.

Lead—Injudicious actions with respect to the sale of some of the Government lead continued to trouble the market. During the early part of the week the market was soft, but in the latter part there was a distinctly firmer tone, and sales were made at 4.80c., around which price several producers were willing to sell. The rally in price may have been due to speculative buying, there having been a good deal of inquiry from speculative interests. Even at the lower prices, however, the big lead manufacturers have not been tempted to buy in the open market. This might be regarded as disappointing, were it not that they were reported to be taking in lead more liberally on average-price contracts, an unusually large proportion of the lead at present going into consumption in that way. Producers report an increase in the demand from manufacturers of lead pipe and plumbers' supplies, which appears to be spreading eastward from the West. This would be a natural development in the face of the prospect for increased building. Japan inquired for lead this week and bought some.

From the standpoint of the lead producer the present situation is very uncomfortable. The three Utah smelters which six weeks ago were running 16 furnaces are today running only 10, and even that number may have to be curtailed. The Utah Apex mine, one of the large producers of Utah, has been closed. Ore supply in Colorado is so short that the Globe plant at Denver is going to be closed. Some of the Coeur d'Alene producers are maintaining a high rate, while others have curtailed operations owing to inability to continue production except at a loss. Without doubt the price under 5c. is effecting a drastic restriction of production.

The American Smelting and Refining Co. maintains its price of 5c.

Zinc—Some considerable business was done, a good deal of which was of speculative character. However, galvanizers bought some. There were sellers on many hands, and the price declined from day to day. This week is noteworthy as the first week since January, 1915, in which the price for spelter has been below 6c.

There was no inquiry for high-grade zinc, and it is impossible to say what the market for it would be.

Zinc dust can be bought at 1.5 the price for common spelter.

Zinc Sheets—The quoted price of zinc sheets is $11 per 100 pounds.

Other Metals

Aluminum—Nominal at 33c.

Antimony—This market was a little firmer, although not very much business was done. During the early part of the week antimony was still to be had at 6¾c., and possibly that price might have been shaded. At the close we quote spot at 7c. Prompt shipments from the Orient are quoted at 6¾@7c.

Bismuth—Metal of the highest purity for pharmaceutical use is quoted at $3.20 per lb. for wholesale lots—500 lb. and over.

Cadmium—Quoted at $1.40 per lb. in lots of 500 pounds.

Nickel—Ingot, 40c.; shot, 43c.; electrolytic, 45c. per pound.

Quicksilver—This market became distinctly firmer. We quote California virgin in New York at $77. San Francisco telegraphs $73, strong.

Silver and Platinum

Silver—The silver situation has been entirely changed by the announcement made on May 6 by the Federal Reserve Board that the existing restrictions on the export of silver were removed, thus reëstablishing an open market for silver. Inasmuch as there has been an accumulation of orders for export for which licenses could not be obtained, it is likely that there will be some advance in price until these orders are filled. The price eventually will be governed by the Indian and Chinese demand. Sellers are holding off, awaiting developments, and the market closes unsettled.

Mexican dollars at New York: May 1, 77¼; May 2, 77½; May 3, 77½; May 5, 77½; May 6, 77½; May 7, 78¼.

Platinum—Refined ingot was strong at $100, with good demand for it.

Palladium—We quote $120@121.

Zinc and Lead Ore Markets

Joplin, Mo., May 3—Blende, per ton, high, $40.95; basis 60% zinc, premium, $37@36; Prime Western, $35@34; sludge and flotation, $33@30; calamine, basis 40% zinc, $25@22. Average settling prices: Blende, $37.04; calamine, $22.62; all zinc ores, $36.74.

Lead, high, $61.70; basis 80% lead, $58@56; average settling price, all grades of lead, $56.11 per ton.

Shipments the week: Blende, 9148; calamine, 199; lead, 1364 tons. Value all ores the week, $419,950.

Some sellers declined to accept the reduction of $1 per ton on Thursday, but by Friday evening most of them were selling.

Producers cannot agree among themselves as to a plan of restriction of output to a level of the market necessity, and those who comprehend the metal situation are expecting a crisis in zinc-ore prices that may close down, by necessity, a large proportion of producing plants.

Platteville, Wis., May 3—Blende, basis 60% zinc, no sales or offerings for premium grades reported; $37 base offered for high-lead blende early in the week, but no sales reported.

No sales of lead ore were reported.

Shipments reported for the week are 2007 tons blende and 694 tons sulphur ore.

For the year to date the totals are 33,751 tons blende, 1720 tons galena, and 2611 tons sulphur ore. During the week 2920 tons blende was shipped to separating plants.

Other Ores

Manganese Ore—A little business was done on the basis of 50c. per unit, delivered at buyers' works, but there was no great interest even at that price.

Molybdenum Ore—No business reported.

Tungsten Ore—The market became very dull. We quote $6@7 for ordinary grades of ore.

Pyrites—Spanish pyrites is quoted at 21c. per unit for furnace ore, c.i.f. New York or any South Atlantic or North Atlantic port.

Iron Trade Review

PITTSBURGH—May 6

The iron and steel market continues to mark time. Instances of increased activity are the exception, the general trend, where there is any, being in the direction of greater dullness. Mill operations are uniformly declining, excepting the case of sheet and tin mills. With somewhat improved demand for electrical sheets, some sheet mills are slightly increasing their operations, though the tin-plate mills are approximately holding their own, operating at about 55% at a time of year when normally they are busy, even if steel demand generally is light.

The majority of the large independent steel interests are operating at slightly less than 50% of capacity, though small interests show widely varying conditions, some operating between 75 and 100% and some being closed entirely. The Steel Corporation is operating at an average of about 65%, and the steel industry as a whole is running at somewhat under 60%, against 77% in March and 87% in January. With a continuance of the trend of the last few weeks, old orders gradually being exhausted and new buying light, the mills would be operating at not over 40% in July.

Buyers of steel are indifferent. They have no price level in mind which they would accept as a basis for making heavier purchases. The everyday buyer, the jobber, and the manufacturing consumer buy in the smallest possible quantities, ordering at frequent intervals and simply paying the market price.

Obviously, the situation calls for an "open market," for, when buyers are unable to determine the prices at which they would be willing to take hold, it requires an active competitive market to give them confidence in prices. The majority of steel salesmen would like to see an open market develop, and many of them believe prices would not recede a great deal in such case, as it is not so much the price itself as the manner in which the price is developed that gives the buyer confidence. The small number of men who control the policies of the large producers apparently believe otherwise, evidently feeling either that there is no large amount of business to be brought out by low prices, or that, with competitive selling, prices would drop to a ruinously low level.

Pig Iron—Furnishing a curious commentary on the fears of leading steel producers that abandonment of the present understanding and establishment of open-market conditions would lead to sharp price declines, the pig-iron market has been an open one, according to the testimony of the merchant furnaces, for fully a month, yet in the western Pennsylvania, Valley and Lake front markets there has not been a single decline from the prices that became effective Mar. 21. Some of the furnaces would be glad to cut prices $1 or $2 a ton to secure an order for 1000 to 5000 tons, but the inquiry does not develop, sales being confined to carloads up to 100 tons, at full prices. An exception is a sale of 500 tons of standard bessemer, at $27,95, Valley, the recognized price, delivery 100 tons a month, but the circumstances of the buyer were somewhat unusual. W. P. Snyder & Co. announce average prices obtaining on sales of Valley iron in April at $27,95 for bessemer, and $25,75 for basic, these being the regular quotations. We quote the market steady to quiet at former prices: Bessemer, $27,95; basic, $25.75; malleable, $26,25; foundry, $26,75; forge, $25.75; f.o.b. Valley furnaces, freight to Pittsburgh being $1.40.

Steel—There is no inquiry for either large or small lots. Deliveries of billets and sheet bars on regular contracts are somewhat lighter. We quote: Billets, $38,50; sheet bars and small billets, $42; slabs, $41; rods, $52.

Ferromanganese—Resale 80% ferromanganese is now available at $110@115 delivered, or $5 decline in the week, producers continuing to quote $150. Resale 18% spiegeleisen is $33@35, delivered.

Coke—The spot furnace coke market is again a shade stiffer, at $3.70@3.75 per net ton at ovens, Connellsville region, the stiffness being due not to increased demand, as demand is light, but to closer adjustment of production to contract requirements. Contract settlements for May deliveries are generally at $4. Spot foundry coke is 4.25@6, depending on brand.

MONTHLY AVERAGE PRICES OF METALS

Silver	New York			London		
	1917	1918	1919	1917	1918	1919
Jan.	75.630	88.702	101.125	36.682	44.356	48.438
Feb.	77.585	85.716	101.125	37.742	42.792	48.027
Mar.	73.861	88.082	101.125	36.410	43.620	48.171
April	73.875	95.346	101.125	36.963	47.215	48.886
May	74.745	99.505	.....	37.940	48.980	.....
June	76.971	99.500	.....	39.065	48.875	.....
July	79.010	99.625	.....	40.110	48.813	.....
Aug.	85.407	100.292	.....	43.418	49.077	.....
Sept.	100.740	101.125	.....	50.920	49.500	.....
Oct.	87.332	101.125	.....	44.324	49.500	.....
Nov.	85.891	101.125	.....	43.584	48.969	.....
Dec.	85.960	101.125	.....	43.052	48.492	.....
Year	81.417	96.772	.....	40.851	47.516	.....

New York quotations cents per ounce troy, 999 fine; London, pence per ounce, sterling silver, 925 fine.

Copper	New York		London			
	Electrolytic		Standard		Electrolytic	
	1918	1919	1918	1919	1918	1919
Jan.	23.500	(a)	110.000	92.238	125.000	106.619
Feb.	23.500	16.763	110.000	78.700	125.000	95.700
Mar.	23.500	14.856	110.000	76.821	125.000	82.071
April	23.500	15.246	110.000	77.300	125.000	82.200
May	23.500	.....	110.000	.....	125.000	.....
June	23.500	.....	110.000	.....	125.000	.....
July	25.904	.....	119.913	.....	134.913	.....
Aug.	26.000	.....	122.000	.....	137.000	.....
Sept.	26.000	.....	122.000	.....	137.000	.....
Oct.	26.000	.....	122.000	.....	137.000	.....
Nov.	26.000	.....	122.000	.....	137.000	.....
Dec.	(a)	.....	118.447	.....	133.167	.....
Year	24.628	.....	115.530	.....	130.507	.....

(a) No Market.

Tin	New York		London	
	1918	1919	1918	1919
January	85.500	67.702	293.227	248.557
February	92.000	66.801	311.525	223.963
March	(a)	67.934	318.875	236.843
April	(a)	72.500	329.905	225.275
May	(a)	.....	364.217	.....
June	(a)	.....	331.925	.....
July	(a)	.....	360.347	.....
August	(a)	.....	380.900	.....
September	(a)	.....	343.905	.....
October	(a)	.....	335.543	.....
November	(a)	.....	323.550	.....
December	(a)	.....	267.736	.....
Av. year	(a)	.....	330.138	.....

(a) No average computed.

Lead	New York		St. Louis		London	
	1918	1919	1918	1919	1918	1919
January	6.782	5.432	6.684	5.316	29.00	37.227
February	6.973	5.057	6.899	4.784	29.00	28.675
March	7.201	5.226	7.091	4.992	29.00	27.952
April	6.772	4.982	6.701	4.722	29.00	24.888
May	6.818	.....	6.704	.....	29.00	.....
June	7.611	.....	7.511	.....	29.00	.....
July	8.033	.....	7.750	.....	29.00	.....
August	8.050	.....	7.750	.....	29.00	.....
September	8.050	.....	7.750	.....	29.00	.....
October	8.050	.....	7.750	.....	29.00	.....
November	8.050	.....	7.750	.....	31.20	.....
December	6.564	.....	6.324	.....	40.00	.....
Year	7.413	.....	7.222	.....	30.10	.....

Spelter	New York		St. Louis		London	
	1918	1919	1918	1919	1918	1919
January	7.836	7.272	7.661	6.922	54.000	56.045
February	7.814	6.623	7.639	6.273	54.000	46.150
March	7.461	6.500	7.286	6.150	54.000	38.500
April	6.890	6.465	6.715	6.114	54.000	36.118
May	7.314	.....	7.114	.....	54.000	.....
June	8.021	.....	7.791	.....	54.000	.....
July	8.688	.....	8.338	.....	54.000	.....
August	8.985	.....	8.635	.....	54.000	.....
September	9.442	.....	9.092	.....	54.000	.....
October	8.801	.....	8.451	.....	54.000	.....
November	8.491	.....	8.141	.....	54.100	.....
December	8.163	.....	7.813	.....	56.050	.....
Year	8.159	.....	7.890	.....	54.180	.....

New York and St. Louis quotations, cents per pound London, pounds sterling per long ton.

Pig Iron Fgh.	Bessemer‡		Basic‡		No. 2 Foundry	
	1918	1919	1918	1919	1918	1919
January	$37.25	$33.60	$33.95	$31.40	$33.95	$32.40
February	37.25	33.60	33.95	31.40	33.95	32.40
March	37.25	32.54	33.95	31.40	33.95	29.12
April	36.15	29.35	32.95	27.15	33.95	28.15
May	36.20	.....	33.00	.....	34.00	.....
June	36.36	.....	33.16	.....	34.16	.....
July	36.60	.....	33.40	.....	34.40	.....
August	36.60	.....	33.40	.....	34.40	.....
September	36.60	.....	33.40	.....	34.40	.....
October	36.60	.....	34.40	.....	35.40	.....
November	36.60	.....	34.40	.....	35.40	.....
December	36.60	.....	34.40	.....	35.40	.....
Year	$36.67	.....	$33.70	.....	$34.45	.....

‡ As reported by W. P. Snyder & Co.

STOCK QUOTATIONS

N. Y. EXCH.† May 5	
Alaska Gold M.	3⅛
Alaska Juneau	2
Am.Sm.&Ref.,com.	73¼
Am.Sm. & Ref., pf.	106
Am.Sm.Sec., pf., A	95
Am. Zinc	17½
Am. Zinc, pf.	48½
Anaconda	63
Batopilas Min.	1
Bethlehem Steel	‡74
Butte & Superior	23½
Butte Cop. & Zinc	8
Cerro de Pasco	40
Chile Cop.	23½
Chino	37½
Colo. Fuel & Iron	44½
Crucible Steel	70¼
Crucible Steel, pf.	95½
Dome Mines	14
Federal M. & S.	12
Federal M. & S., pf.	39½
Great Nor., ore ctf.	45¼
Greene Cananea	40
Gulf States Steel	54½
Homestake	89
Inspiration Con.	50⅛
International Nickel	25
Kennecott	32½
Lackawanna Steel	71
Mexican Petrol.	176¼
Miami Copper	23½
Nat'l Lead, com.	74⅛
National Lead, pf.	110
Nev. Consol.	16½
Ontario Min.	7
Ray Con.	20½
Republic I.&S.,com.	82½
Republic I.&S., pf.	103½
Sloss-Sheffield	53½
Tennessee C. & C.	16½
U. S. Steel, com.	99
U. S. Steel, pf.	115⅛
Utah Copper	77½
Va. Iron C. & C.	60
Worthington Pump	67½

BOSTON CURB* May 6	
Boston Ely	1
Boston & Mont.	.76
Butte & Lon'n Dev.	.11
Calaveras	.50
Chief Con.	3⅛
Contact	.05
Corbin	‡.25
Cortez	.15
Crown Reserve	.35
Crystal Cop.	.20
Eagle & Blue Bell	2⅛
First Nat. Cop.	1⅛
Gadsden Cop.	3½
Houghton Copper	.20
Intermountain	‡.05
Iron Blossom	.40
Iron Cap.	10
Majestic	.16
Mexican Metals	.15
Mines of America	‡.05
Mojave Tungsten	.10
Nat. Zinc & Lead	.13
Nevada-Douglas	.15
New Baltic	1
Oneco	.20
Pacific Mines	‡.25
Rex Cons.	.14
Yukon Gold	.76

SAN FRAN.* May 5	
Alta	.08
Andes	‡.25
Best & Belcher	.34
Caledonia	.24
Challenge Con.	‡.03
Confidence	‡.03
Con. Virginia	2.95
Gould & Curry	.14
Hale & Norcross	‡.17
Jacket-Cr. Pt.	.14
Mexican	.61
Occidental	.40
Ophir	1.95
Overman	.10
Savage	.14
Sierra Nevada	.22
Union Con.	.43
Utah Con.	‡.04
Belmont	3.00
Jim Butler	.83
MacNamara	.02
Midway	.59
Mont.-Tonopah	.20
North Star	.09
Rescue Eula	.22
West End Con.	1.95
Atlanta	.05
Booth	‡.30
Comb. Frac.	‡.03
Florence	.43
Jumbo Extension	.14
Kewanaa	.05
Nevada Hills	.05
Nevada Packard	.20
Round Mountain	.40
Silver Pick	.11
White Caps	.25

COLO. SPRINGS* May 5	
Cresson Con.	4.81½
Doctor Jack Pot	.04
Elkton Con.	06½
El Paso	.18
Gold Sovereign	‡.02
Golden Cycle	1.80
Granite	.14
Isabella	.05½
Mary McKinney	.07½
Portland	1.01
United Gold M.	.17
Vindicator	.30

BOSTON EXCH.† May 6	
Adventure	‡.50
Ahmeek	.70
Algomah	.20
Alloues	.35
Aris. Com.	.12
Arnold	‡.20
Bingham Mines	.7½
Bonanza	‡.10
Butte-Balaklava	.25
Calumet & Aris.	.59½
Calumet & Hecla	375
Centennial	‡12
Copper Range	42½
Daly West	‡2½
Davis-Daly	5
East Butte	8
Franklin	2
Granby	‡66⅛
Hancock	5
Hedley	‡12
Helvetia	1⅛
Indiana	‡.50
Isle Royale	25
Keweenaw	2½
Lake	‡4½
La Salle	2
Mason Valley	‡2½
Mass	4
Mayflower	4½
Michigan	4½
Mohawk	56
New Arcadian	1
New Cornelia	17⅛
New Idria	9
Nipissing	9½
North Butte	10
North Lake	‡.25
Ojibway	‡1½
Old Dominion	32½
Osceola	46
Quincy	54½
St. Mary's M. L.	‡.43
Santa Fe	‡.38
Seneca	15
Shannon	2
Shattuck-Aris.	‡11
So. Lake	‡.75
So. Utah	‡.12
Superior	‡5½
Superior & Bost.	‡2
Trinity	2½
Tuolumne	‡.81
U. S. Smelting	55
U. S. Smelting, pf.	49
Utah Apex	1½
Utah Con.	‡7⅛
Utah Metal	2
Victoria	2
Winona	.85
Wolverine	15½

N. Y. CURB† May 5	
Am. Tin & Tung.	‡
Big Ledge	⅛
Butte & N. Y.	⅛
Butte Detroit	‡.04
Caledonia	‡.32
Calumet & Jerome	‡
Can. Cop. Corpn.	1
Carlisle	‡2
Cashboy	.10
Con. Aris. Sm.	1
Con. Coppermines	‡8
Goldfield Con.	.18
Goldfield Merger	.03
Hecla Min.	5
Howe Sound	3½
Jerome Verde	‡⅛
Louisiana	1
Magma	‡31
Marsh	‡.07
McKinley-Dar-Sa.	‡.48
Milford	‡.75
Mother Lode	.45
Nixon Nevada	.20
Ohio Copper	‡.50
Rawley	‡2½
Ray Hercules	2
Richmond	‡.50
Rochester Mines	.20
St. Joseph Lead	13
Standard S. L.	⅛
Stewart	‡.36
Success	‡.05
Tonopah	3½
Tonopah Divide	10½
Tonopah Ex.	2½
Tribullion	‡.25
Troy Arizona	‡.10
United Eastern	‡4½
United Verde Ext.	36
United Zinc	⅞
Utica Mines	‡.08

TORONTO* Apr. 29	
Adanac	.17
Bailey	.03
Beaver Con.	.45
Chambers Feriand	‡.10
Coniagas	2.00
Hargraves	.02
Kerr Lake	5.37½
La Rose	.25
Lake Shore	.93
Min. Corp. of Can.	2.00
Peterson Lake	.06
Temiskaming	.34
Wettlaufer-Lor.	.04
Davidson	‡.68
Dome Exten.	.27
Dome Lake	.24
Hollinger	6.37½
McIntyre	1.62½
Newray	.12½
Pocu. Crown	.25
Teck-Hughes	15
Vipond	.20
West Dome	.12

* Bid prices. † Closing prices. ‡ Last quotations.

Current Prices—Materials and Supplies

IRON AND STEEL

SHEETS—Quotations are in cents per pound in various cities from warehouse, also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	St. Louis	Chicago	San Francisco	New York Current	New York One Yr. Ago
No. 10	3.55	4.29	4.57	5.80	4.57	5.45
No. 12	3.60	4.34	4.62	5.75	4.62	5.50
No. 14	3.65	4.39	4.67	5.90	4.67	5.55
Black						
Nos. 18 and 20	4.15	5.04	5.17	6.75	5.42	6.25
Nos. 22 and 24	4.20	5.14	5.22	6.80	5.47	6.30
No. 26	4.25	5.19	5.27	6.95	5.52	6.40
No. 28	4.35	5.29	5.37	7.05	5.62	6.45
Galvanized:						
No. 10	4.70	5.64	5.72	....	5.97	6.70
No. 12	4.80	5.64	5.82	7.30	6.02	6.80
No. 14	4.80	5.64	5.82	7.30	6.07	6.80
Nos. 18 and 20	5.10	5.84	6.12	7.60	6.37	7.10
Nos. 22 and 24	5.25	5.99	6.25	7.75	6.52	7.25
No. 26	5.40	5.69	6.42	7.90	6.67	7.40
No. 28	5.70	6.44	6.72	8.20	6.97	7.70

STEEL RAILS—The following quotations are per gross ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Current	Pittsburgh One Year Ago	Chicago Current	Chicago One Year Ago
Standard bessemer rails	$45.00	$65.00	$45.00	$65.00
Standard openhearth rails	47.00	67.00	47.00	67.00
Light rails, 8 to 10 lb	2.58½*	3.36*	2.83½*	3.36½*
Light rails, 12 to 14 lb	2.54*	3.09*	2.79*	3.09*
Light rails, 25 to 45 lb	2.45*	3.00*	2.70*	3.00*

*Per 100 lb.

TRACK SUPPLIES—The following prices are base per 100 lb. f. o. b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Current	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco
Standard railroad spikes, ⅝-in. and larger	$3.25	$3.90	$4.27	$5.04	$6.15
Track bolts	4.90	4.90	5.17	Premium	7.20
Standard section angle bars	3.00	3.25	4.22	Premium	4.60

STRUCTURAL MATERIAL—The following are the base prices f. o. b. mill, Pittsburgh, together with the quotations per 100 lb. from warehouses at the places named:

	Mill Pittsburgh	New York Current	New York 1 Yr. Ago	St. Louis	Chicago
Beams, 3 to 15 in	$2.45	$3.47	$4.195	$3.39	$3.47
Channels, 3 to 15 in	2.45	3.47	4.195	3.39	3.47
Angles, 3 to 6 in. ¼ in. thick	2.45	3.47	4.195	3.39	3.47
Tees, 3 in. and larger	2.45	3.52	4.195	3.39	3.47
Plates	2.66	3.67	4.445	3.39	3.67

STEEL SHEET PILING—The following price is base per 100l b. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

Current	One Month Ago	One Year Ago
$2.5	$2.25	$4–5

RIVETS—The following quotations are per 100 lb.:

	Mill Pittsburgh	Warehouse New York Current	Warehouse New York One Year Ago	Warehouse Chicago	Warehouse St. Louis	Warehouse San Francisco	Dallas
½-in. and larger	$4.20	$5.05	$6.095	$4.87	$4.94	$6.70	$6.75
CONE HEAD BOILER							
½ in. and larger	4.30	5.15	6.195	4.97	5.04	6.80	6.75
⅝ and ¾	4.45	5.30	6.345	5.12	5.19	6.95	6.90
⅞ and 1	4.70	5.55	6.695	6.47	5.44	7.30	7.15

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	New York and St. Louis
Galvanized iron rigging	+12½%
Galvanized cast steel rigging	7½%
Bright plow steel	35%
Bright cast steel	22½%
Bright iron and iron tiller	5%

HORSE AND MULE SHOES—Warehouse prices per 100 lb. in cities named:

	Mill Pittsburgh	Cincinnati	Chicago	St. Louis	Denver	Birmingham
Straight	$5.75	$7.50	$6.50	$6.25	$8.50	$7.35
Assorted	....	7.50	6.50	6.40	8.75	7.60

BAR IRON AND STEEL—Per pound to large buyers at mill, Pittsburgh:

Iron bars 2.75c. Steel bars 2.25c.

COAL BIT STEEL—Warehouse price per pound is as follows:

New York	Cincinnati	Birmingham	St. Louis	Denver	Chicago
$0.12	$0.16½	$0.18	$0.19	$0.18½	$0.16½

DRILL STEEL—Warehouse price per pound:

	New York	St. Louis	Birmingham	Denver
Solid	14c.	14c.	15c.	16c.
Hollow	21c.	25c.	..	25c.

STEEL AND IRON PIPE—The following discounts are for carload lots f. o. b. Pittsburgh, basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's for iron, both dated Mar. 21, 1919.

Inches	Steel Black Per Cent.	Galvanized Per Cent.	Inches	Iron Black Per Cent.	Galvanized Per Cent.
BUTT WELD					
⅛ to 3	57½	44	⅛ to 1¼	39½	23½
LAP WELD					
2	50½	38	1¼	24½	9½
2½ to 6	53½	41	1½	31½	17½
7 to 12	50½	37	2	32½	18½
13 and 14	41	..	2½ to 6	34½	21½
15	38½	..	7 to 12	31½	18½
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜	46½	29	⅛, ¼ and ⅜	28½	11½
½	51½	39	½	33½	20½
¾ to 1¼	55½	43	¾ to 1½	39½	24½
2 to 3	56½	44			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	48½	37	1½	25½	10½
2½ to 4	51½	40	1½	31½	17½
4½ to 6	50½	39	2	33½	20½
7 to 8	46½	33	2½ to 4	35½	23½
9 to 12	41½	28	4½ to 6	34½	22½
			7 to 8	26½	14½
			9 to 12	21½	9½

From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Cleveland	Black Chicago
⅛ to 3 in. butt welded	47%	46½%	71½%
3½ to 6 in. lap welded	42%	42½%	53½%
	Galvanized New York	Galvanized Cleveland	Galvanized Chicago
⅛ to 3 in. butt welded	31%	31%	44%
3½ to 6 in. lap welded	27%	27½%	41%

Malleable fittings, Class B and C, from New York stock sell at list plus 15%. Cast iron, standard sizes, 10%.

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York Current	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Hot pressed square	$0.25	$1.00	$1.90	$1.40	$1.28	$1.05
Hot pressed hexagon	.25	1.00	1.90	1.20	1.08	.85
Cold punched square	2.25	1.00	1.90	.75	1.30	1.50
Cold punched hexagon	2.25	1.00	1.90	.75	1.30	1.50

Semifinished nuts sell at the following discounts from list price:

	Current	One Year Ago
New York	50–10%	40%
Chicago	50%	50%
Cleveland	50–30%	60%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
⅜ by 4 in. and smaller	40%	50%	45–5%
Larger and longer up to 1 in. by 30 in.	50%	40%	40%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:
New York $2.00 Cleveland $2.00 Chicago $2.25

For cast-iron washers the base price per 100 lb. is as follows:
New York $5.00 Cleveland $4.00 Chicago $4.00

CONSTRUCTION MATERIALS

ROOFING MATERIALS—Prices per ton f. o. b. New York and Chicago:

	Carload Lots N. Y.	Carload Lots Chicago	Less Than Carload Lots N. Y.	Less Than Carload Lots Chicago
Tar felt (14 lb. per square of 100 sq.ft.)	$52.00	$52.50	$53.00	$53.50
Tar pitch (in 400-lb. bbl.)	19.00	16.00	20.00	17.00
Asphalt pitch (in barrels)	36.00	36.00	41.50	41.50
Asphalt felt	67.50	67.50	72.00	72.00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square as follows in New York, St. Louis, Chicago and San Francisco:

	1-Ply c.l.	1-Ply l.c.l.	2-Ply c.l.	2-Ply l.c.l.	3-Ply c.l.	3-Ply l.c.l.
No. 1 grade	$1.35	$1.60	$1.70	$1.95	$2.05	$2.30
No. 2 grade	1.20	1.45	1.50	1.75	1.80	2.05

Asbestos asphalt-saturated felt (14 lb. per square) costs $5.00 per 100 lb.

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $1.80 per roll in carload lots and $2.05 for smaller quantities.

Shingles, red and green slate finish, cost $5.00 per square in carloads, $5.25 in smaller quantities, in Philadelphia.

HOLLOW TILE—

	4 x 12 x 12	8 x 12 x 12	12 x 12 x 12
St. Paul	$0.056	$0.11	$0.162
Seattle	.09	.175	.30
Los Angeles*	.082	.154	.236
New Orleans	.12	.15	.20

* F.o.b. factory, 4, 8 and 10 inch.

LUMBER—Price per M in carload lots:

	8 x 8-In. x 20 Ft. and Under				12 x 12-In. 20 Ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston	$46.50	$45.00	$45.00	$46.00	$52.00	$46.00
Cincinnati	37.00	.....	36.00	.....	41.00	.....
Kansas City	40.50	43.50	41.50	$39.50	45.50	43.50
Seattle	17.50	17.50	17.50	17.50	17.50	17.50
New Orleans	31.50 (No. 1)		.....	.....	36.50	
St. Paul	46.00	50.00	46.00	46.00	.....	53.00
Denver	44.00	36.50	36.50	.....	49.00	39.00
Atlanta	35.50	.....	.....	.....	40.50	.....

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	Y.P.	Fir
Boston	$50.00	$45.00	$40.00	$45.00	$48.50
Cincinnati	50.50	40.00	40.00	48.50	44.50
Kansas City	50.00	57.75	55.75	53.50	63.00
Seattle	17.50	17.50	17.50	17.50	17.50
New Orleans	34 and $41 for No. 1 and No. 2			31.50 (No. 1)	
St. Paul	50.50	40.00	40.00	48.50	45.50
Denver	45.00	35.50	35.50	38.00	32.00
Atlanta	20.00	.....	.....	33.00	.....
Los Angeles	.....	31.00	30.00	.....	.....

* Los Angeles: Base price of fir is $32; of hemlock, $34; redwood, $35.

NAILS—The following quotations are per keg from warehouse:

	Mill Pittsburgh	St. Louis	Dallas	Chicago	San Francisco
Wire	$3.25	$4.00	$4.37	$5.00	$4.75
Cut	3.45	6.50	6.50	5.75	.....

PORTLAND CEMENT—These prices are for barrels in carload lots, without bags.

	Current	One Month Ago	One Year Ago with Bags
New York	$2.30	$2.45	$2.55
Jersey City	2.27	2.62	2.50
Boston	2.57	2.57	2.87
Chicago	2.00	2.05	2.36
Pittsburgh	2.05	2.15	2.71
Cleveland	2.22	2.32	2.84
Denver	2.67	2.67	3.20

Note—Charge for bags is generally 15c. each, 60c. per bbl.

LIME—Warehouse prices:

	Hydrated per Ton		Lump per 300-Lb. Barrel	
	Finished	Common	Finished	Common
New York	$17.50	$14.50	$2.90	$2.65
Kansas City	21.00	.....	.....	2.20*
Chicago	18.00	17.50	1.80*	1.10*
St. Louis	22.00	18.00	.....	1.75*
Boston	22.50	18.25	3.65	3.30
Dallas	2.25*	1.25*	.....	.....
San Francisco	19.00	.....	.....	2.00†
St. Paul	23.00	19.50	1.60*	1.50*
New Orleans	.....	.....	.....	1.65*
Atlanta	.....	18.50	.....	1.50*
Los Angeles	.....	.....	3.05†	2.80*
Denver	.....	26.25	.....	2.50*

* 200-lb. barrels. † Per 180-lb. bbl. ‡ Per ton.
Note—Refund of 10c. per barrel.

LINSEED OIL—These prices are per gallon:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Raw per barrel	$1.63	$1.55	$1.71	$1.65	$1.80	$1.65
5-gal. cans	1.76	1.65	1.81	1.80	2.00	1.75

WHITE AND RED LEADS in 500-lb. lots sell as follows in cents per pound

	Red				White	
	Current		1 Year Ago		Current Dry and In Oil	1 Yr. Ago Dry and In Oil
	Dry	In Oil	Dry	In Oil		
100-lb. keg	13.00	14.50	11.25	11.00	13.00	10.50
25- and 50-lb. kegs	13.25	14.75	11.50	11.25	13.25	10.75
12½-lb. keg	13.50	15.00	11.75	11.50	13.50	11.00
5-lb. cans	15.00	16.50	13.25	13.00	15.00	13.00
1-lb. cans	16.00	17.50	13.25	13.00	16.00	13.00

MINING AND MILLING SUPPLIES

HOSE—

	Fire	50-Ft. Lengths
Underwriters' 2½-in.		75c. per ft.
Common, 2½-in.		30%

	Air		
	First Grade	Second Grade	Third Grade
¾-in. per ft.	$0.55	$0.40	$0.30

Steam—Discounts from List

First grade..... 25% Second grade..... 35% Third grade..... 40%

LEATHER BELTING—Present discounts from list in the following cities are as follows:

	Medium Grade	Heavy Grade
New York	45%	40%
St. Louis	45%	50%
Chicago	45%	40%
Birmingham	35%	35%
Denver	35–5%	30%

RAWHIDE LACING—50c. for cut; 45c. per sq.ft. for ordinary.

MANILA ROPE—For rope smaller than ¼-in. the price is ¼ to 2c. extra; while for quantities amounting to less than 600 ft. there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¼-in., 8 ft., ½-in., 6; ¾-in., 4½; 1-in., 3½; 1¼-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following is price per pound for ¼-in. and larger, in 1200-ft. coils:

Boston	$0.26	Denver	$0.29½
New York	.28	Kansas City	.29
Cincinnati	.29	New Orleans	.28½
Chicago	.26½	Seattle	.27½
St. Paul	.28	St. Louis	.27
San Francisco	.26	Atlanta	.28

PACKING—Prices per pound:

Rubber and duck for low-pressure steam	$0.95
Asbestos for high-pressure steam	1.60
Duck and rubber for piston packing	1.00
Flax, regular	1.20
Flax, waterproofed	1.60
Compressed asbestos sheet	1.00
Wire insertion asbestos sheet	1.20
Rubber sheet	.60
Rubber sheet, wire insertion	.80
Rubber sheet, duck insertion	.50
Rubber sheet, cloth insertion	.30
Asbestos packing, twisted or braided and graphited, for valve stems and stuffing boxes	1.20
Asbestos wick, ¾- and 1-lb. balls	.85

REFRACTORIES—Following prices are f. o. b. works, Pittsburgh:

Chrome brick	net ton	$120.00 at Chester, Penn.
Chrome cement	net ton	65.00 at Chester, Penn.
Clay brick, 1st quality fireclay	net ton	40–30 at Clearfield, Penn.
Clay brick, 2nd quality	net ton	38–48 at Clearfield, Penn.
Magnesite, dead burned	net ton	37.50 at Chewalah, Penn
Magnesite brick, 9 x 4½ x 2½ in.	net ton	90.00 at Chester, Penn.
Silica brick	net ton	45–55 at Mt. Union, Penn.

Standard size fire brick, 9 x 4½ x 2½ in. The second quality is $4 to $5 cheaper per 1000.
St. Louis—Fire Clay, $35 to $50.
Birmingham—Fire clay, $40–$45; silica, $40–$50; magnesite, $90; chrome, $120
Chicago—Second quality, $25 per ton.

RAILWAY TIES—For fair size orders, the following prices per tie hold:

	Material	7 In. x 9 In. by 8 Ft. 6 In.	6 In. x 8 In. by 8 Ft.
Chicago	Plain	1.48	1.33
San Francisco	Douglas Fir—Green	1.35	.96
San Francisco	Douglas Fir—Creosoted	2.70	1.92

Prices per tie at Missouri mills; St. Louis prices about 25c. higher:

Untreated A Grade White Oak 6x8x8		Untreated A Grade Red Oak 6x8x8	
No. 1	$0.70	No. 1	$0.55
No. 2	.80	No. 2	.65
No. 3	.90	No. 3	.75
No. 4	.98		
7x9x8 white oak	.....		1.05
7x9x8 red oak, No. 4	.80	No. 5	.87

FLOTATION OILS—Prices of oils for flotation, in cents per gallon, in barrels.

	New York	Chicago In Bbl.	Chicago Carloads	Denver In Bbl Lots.
Pure steam-distilled pine oil, sp. gr. 0.925-0.94	$0.68	$0.71	$0.69	$ 0.81
Pure destructively distilled pine oil	.68	.68†	.66†	.53–.68
Pine tar oil, sp.gr. 1.02=1.035	.45	.36	.34	.40–.47
Crude turpentine	.51	.68	.66	.50–.63
*Hardwood creosote, sp.gr. 0.96–0.99	.24	.....	.....	.50–.57

* F.o.b. Cadillac, Mich. † Very scarce.

COTTON WASTE—The following prices are in cents per pound:

	New York			
	Current	One Year Ago	Cleveland	Chicago
White	11.00 to 13.00	13.00	16.50	12.00 to 16.50
Colored mixed	8.50 to 12.00	10.00	13.00	11.50 to 14.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½ x 13½	13½ x 20½
Cleveland	$52.00	$58.00
Chicago	48.00	50.00

EXPLOSIVES—Price per pound of dynamite in small lots and price per 25 lb. keg for black powder:

	Low Freezing 20%	Gelatin 40%	Gelatin 60%	Gelatin 80%	Black Powder
New York	.....	$0.27½	$0.30	.....	$2.40
Boston	$0.22½	.24½	.26½	$0.31	2.40
Cincinnati	.19½	.21½	.23½	.....	2.35
Kansas City	.19	.23½	.26½	.30	2.45
New Orleans	.23½ (50%)	.22½	.24½	.....	.....
Seattle	.....	.18½	.21	.....	.....
Chicago	.18½	.21½	.25½	.....	.....
St. Paul	.19	.23½	.26½	.....	2.45
St. Louis	.19	.23½	.25½	.30	2.35
Denver	.17½	22	.24½	.28½	2.60
Dallas	.189	.225	.228	.342	.....
Los Angeles	.19	.24	.27	.....	2.75

CHEMICALS

SODIUM CYANIDE—New York price is 30c. per lb.; Denver, 42c.; Chicago, 31½c.; St. Louis, 31c.

SODIUM SULPHIDE—In New York the price per pound is 4½c. for concentrated, 2c. for crystals. The St. Louis price is 6c. for concentrated, 5½c. for fused; 3½c. for crystals. The Chicago price is 6c. for concentrated, 3½c. for crystals. Concentrated comes in 500-lb. drums, the crystals in 440-lb. bbl.

ZINC DUST—For 350 mesh the New York price is 12c. per lb.; Chicago, 13c.; Denver, 13c. f. o. b. Pueblo; St. Louis, 12c., less than car lots 13c.

ALUMINUM DUST—Chicago price is 1.30 per lb.; Denver, 40c.

MINERS' LAMP CARBIDE—Prices net f.o.b. cars at warehouse points.

	Union 100-Lb. Drums Per Ton	Cameo 100-Lb. Drums Per Ton	Union 25-Lb. Drum Per Drum
East of the Mississippi, North of Chattanooga	$106.00	$101.00	$1.52
Southeastern portion U. S. A.	115.50	110.50	1.63
Texas (except El Paso)	124.00	119.00	1.74
El Paso, Texas	126.00	121.00	1.77
Denver, Colo.	124.00	119.00	1.74
West Coast	129.00	124.00	1.81